
DESIGN AND IMPLEMENTATION OF A DEPARTMENTAL ENQUIRY CHATBOT BASED ON NATURAL LANGUAGE PROCESSING (NLP)

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ABSTRACT

A chatbot or conversational agent aims to make a conversation between both humans and machines. The machine has embedded knowledge to identify the sentences and decide itself as a response to answer a question. One of the main tasks in artificial intelligence and natural language processing is the modeling of conversation. The response principle matches the input sentence from the user. The present technical project consists of developing an expert system for an enquiry desk using Natural language processing, through Artificial Intelligence technology and virtual assistance (Human-machine conversation), transmitting natural language to a server. Often, we tend to spend our time interacting with varied chatterboxes on the web, targeted at such functions or simply amusement. The chatbot has embedded data that helps it acknowledge the user's question and supply a solution to that. The departmental inquiry chatbot project is intended to exploit algorithms that interpret user queries and perceive the user's message.

This technique is an internet application that gives answers to the student's question. In this project, I performed a detailed survey on recent works and examined publications from the last five years, which are related to chatbots. Then presented different related works to the subject, and the AI concepts needed to build an intelligent conversational agent based on deep learning models Finally, I presented a functional architecture that will be proposed to build an intelligent chatbot for the department.

Keywords: Artificial Intelligence, Conversational Agents, Virtual Assistance, Modeling Of Conversation, Exploitation Algorithms, Functional Architecture.

I. INTRODUCTION

In recent years, advancements in Natural Language Processing (NLP) have revolutionized the way humans interact with technology. NLP, a subfield of artificial intelligence, focuses on enabling computers to understand, interpret, and generate human language. This transformative capability has led to the development of intelligent systems that can understand and respond to user queries in natural language, known as chatbots. Chatbots are being employed across various domains to enhance user engagement, streamline communication, and provide efficient access to information.

The educational sector is one such domain that can benefit from the integration of NLP-powered chatbots. In educational institutions, especially in large universities or colleges, students and faculty often need to seek information from different departments. The process of information retrieval through traditional methods, such as manual inquiries or website searches, can be time-consuming and inefficient. To address this challenge, the implementation of a Departmental Enquiry Chatbot emerges as a viable solution.

The objective of this study is to design and implement a Departmental Enquiry Chatbot that utilizes Natural Language Processing techniques. This chatbot aims to provide a user-friendly and efficient means for students and faculty to inquire about various department-related information, such as course details, faculty office hours, upcoming events, and administrative processes. By leveraging NLP, the chatbot will be capable of understanding user queries expressed in natural language and responding with accurate and relevant information.

This paper presents the design and implementation of the Departmental Enquiry Chatbot, discussing the methodologies and NLP techniques employed. The chatbot's architecture, which includes components for

natural language understanding and generation, will be detailed. Additionally, the paper addresses the challenges faced during the development and integration of the chatbot, along with security and privacy considerations. The performance and effectiveness of the chatbot will be evaluated through user interaction scenarios and metrics.

As the educational landscape continues to evolve in the digital age, the adoption of NLP-based chatbots offers the potential to enhance communication and information access within institutions. This study contributes to the existing body of knowledge by providing insights into the design and implementation of a Departmental Enquiry Chatbot, demonstrating the practicality and benefits of integrating NLP in educational environments.

This work aims to Design and Implement a department inquiry chatbot based on Natural Language Processing to provide a fast and convenient way for students to get information about the Department of Computer Engineering, University of Benin.

II. METHODOLOGY

The development of the Departmental Enquiry Chatbot is guided by a comprehensive methodology that encompasses the various stages of design, implementation, and evaluation. The methodology draws inspiration from established practices in Natural Language Processing (NLP) and chatbot development while tailoring them to the specific context of departmental inquiries within educational institutions.

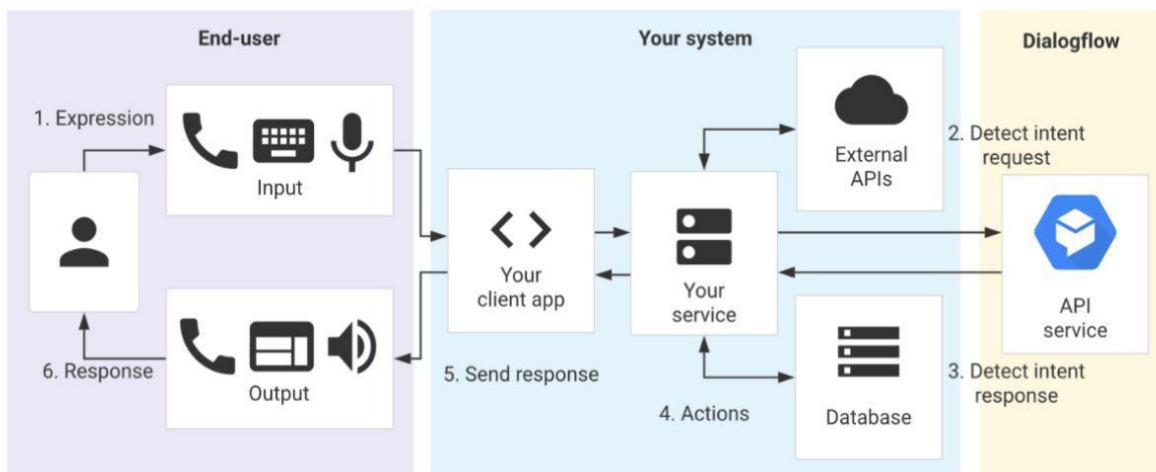


Figure 1: Full architecture of the chatbot system

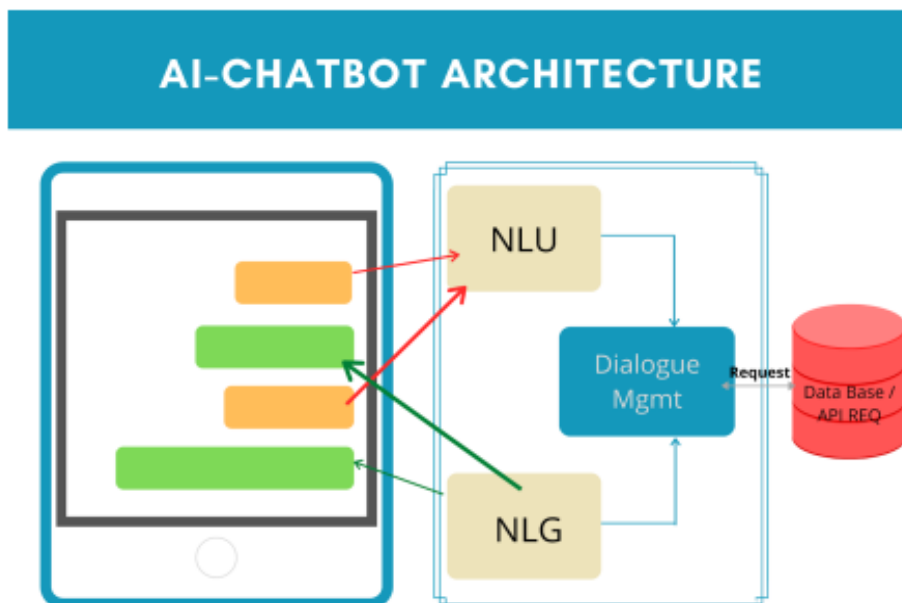


Figure 2: Chatbot architecture

1. Data Collection and Preprocessing:

Gather a diverse dataset of historical inquiries and responses related to departmental information. Preprocess the dataset by cleaning and formatting the text, removing noise, and standardizing language.

2. Intent Recognition and Entity Extraction:

Implement an intent recognition model using machine learning techniques such as Support Vector Machines (SVM) or deep learning architectures like Recurrent Neural Networks (RNN).

Train the model on the preprocessed dataset to accurately classify user intents.

Develop entity extraction components using Named Entity Recognition (NER) to identify relevant information within user queries.

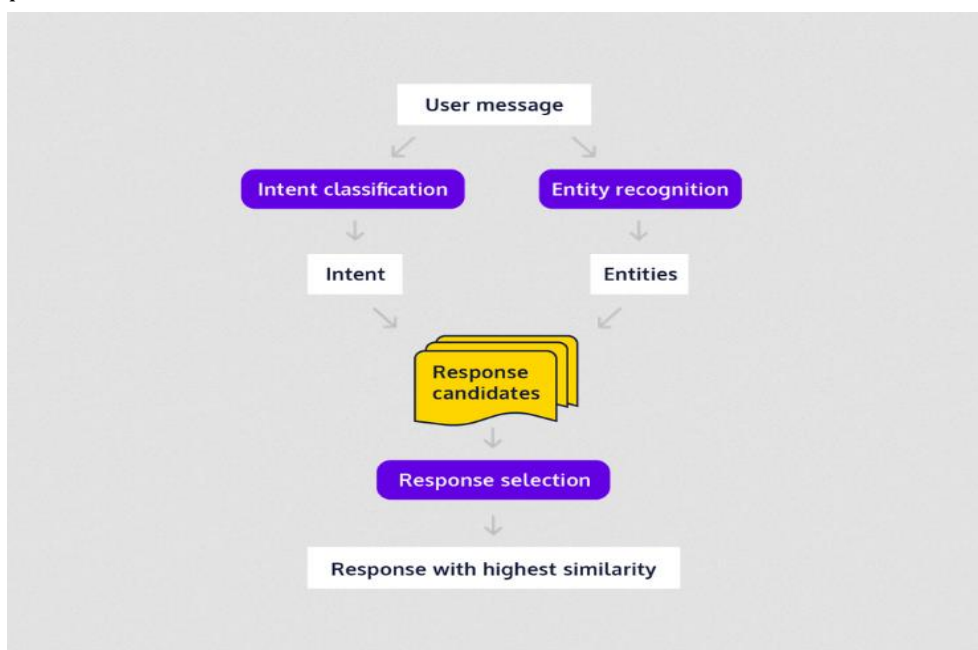


Figure 3: Intent Recognition and Entity extraction of the chatbot system

3. Dialogue Management:

Design a dialogue management system that maintains context and coherence throughout the conversation. Implement a rule-based dialogue manager for simple interactions and integrate reinforcement learning or deep learning models for more complex and dynamic dialogues.

4. Response Generation:

Utilize techniques such as sequence-to-sequence models or transformers to generate contextually appropriate responses. Incorporate templates for commonly asked questions and dynamically generate responses for unique inquiries.

5. User Interface and Integration:

Create a user-friendly interface for users to interact with the chatbot, including a web-based interface and potential integration with messaging platforms. Ensure compatibility with various devices, browsers, and screen sizes.

6. Testing and Evaluation:

Conduct iterative testing with a focus group to identify potential issues and areas of improvement. Evaluate the chatbot's accuracy in intent recognition, entity extraction, and response generation using appropriate metrics. Collect user feedback and adjust the system based on user interactions.

7. Deployment and Monitoring:

Deploy the chatbot on the institution's website or other relevant platforms. Implement monitoring tools to track user interactions, identify user needs, and gather insights for further enhancements.

8. Ethical Considerations: Address privacy and security concerns by implementing data encryption and ensuring user data confidentiality. Implement measures to prevent the chatbot from generating biased or inappropriate responses.

9. Continuous Improvement: Regularly update the chatbot's knowledge base and responses to accommodate changing departmental information and user needs. Implement feedback loops to continuously improve the chatbot's performance and accuracy.

10. User Training and Support:

Provide training to users on how to effectively interact with the chatbot to obtain accurate and relevant information. Offer user support for cases when the chatbot may not fully understand complex queries.

This methodology blends established NLP techniques with innovative approaches to address the unique challenges of creating a Departmental Enquiry Chatbot. Through rigorous data preprocessing, accurate intent recognition, coherent dialogue management, and user-centered design, the chatbot aims to provide a seamless and efficient means of accessing departmental information, enhancing communication within the educational institution.

11. Testing and Evaluation

Perform extensive testing of the chatbot's functionality. Test with several types of queries, including edge cases. Evaluate the chatbot's accuracy, efficiency, and user experience. Gather user feedback for improvements.

12. Deployment

Deploy the chatbot on the desired platforms. Ensure scalability and responsiveness. Monitor the chatbot's performance in production and make necessary adjustments.

13. Maintenance and Support

Provide ongoing maintenance and support to address issues, improve performance, and add new features as required.

Flowchart of the System

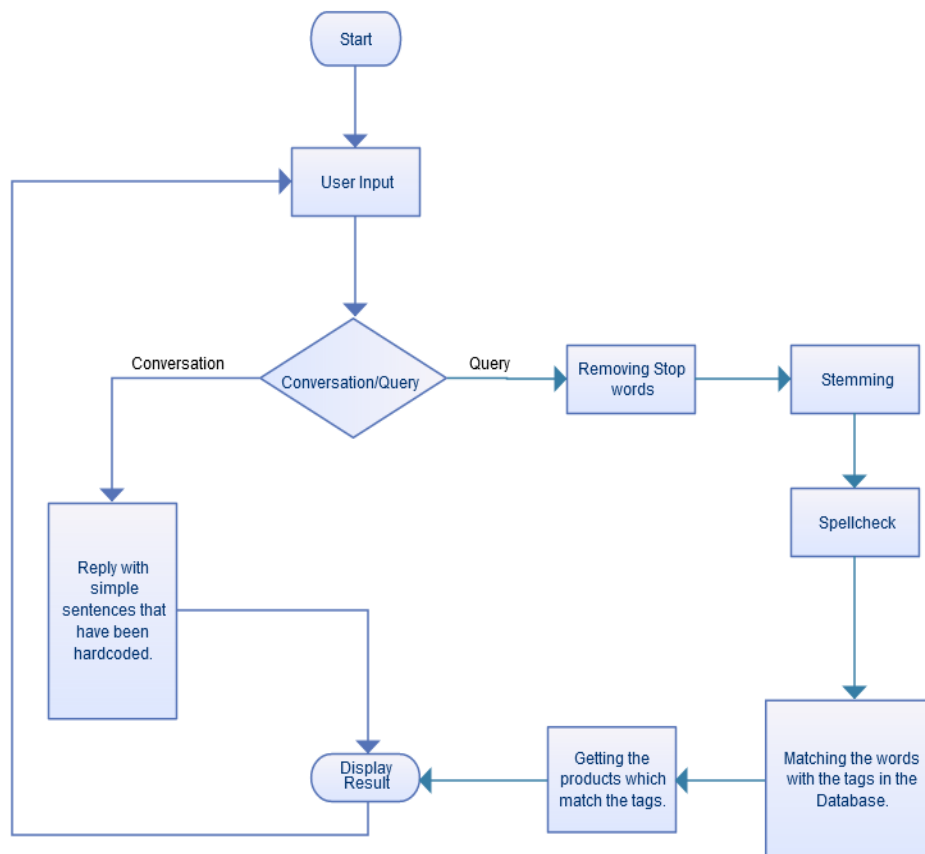


Figure 4: Chatbot flowchart

III. RESULTS AND DISCUSSION

Login Page

This interface is the login page where appropriate login details such as Username and Matriculation Number need to be provided to gain access to the chatbot system, if the identity is invalid the access will be denied.

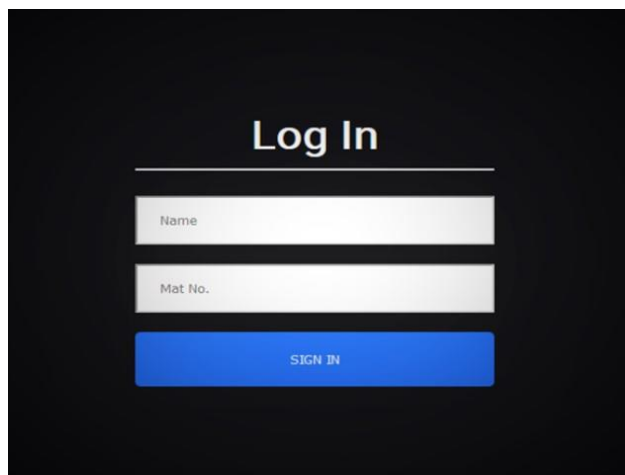


Figure 5: Chatbot login page

Chatbot Page

The figure below shows the chatbot interface where the user-to-chatbot interaction takes place. The chatbot interface is where users (students or staff) can fully interact with the chatbot and get correct date responses. This page provides a platform where users interact with the chatbot and ask questions to get information relating to the Department of Computer Engineering.

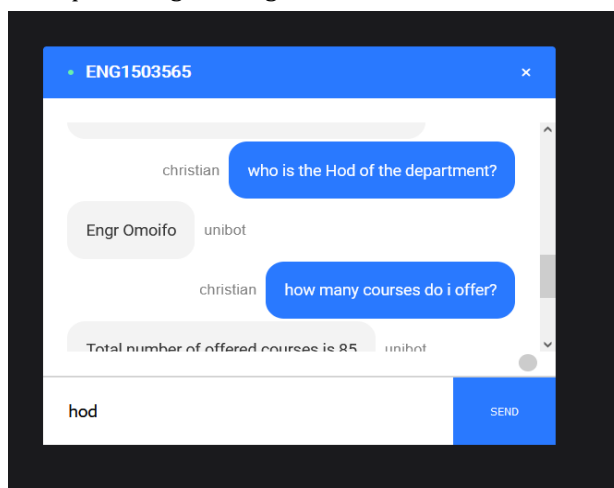


Figure 6: Chatbot page

Admin Portal

The admin portal is where information and items are saved, updated, added to, and subtracted from. The admin dashboard contains content like information about the department, content relating to students of the department, News updates, etc.

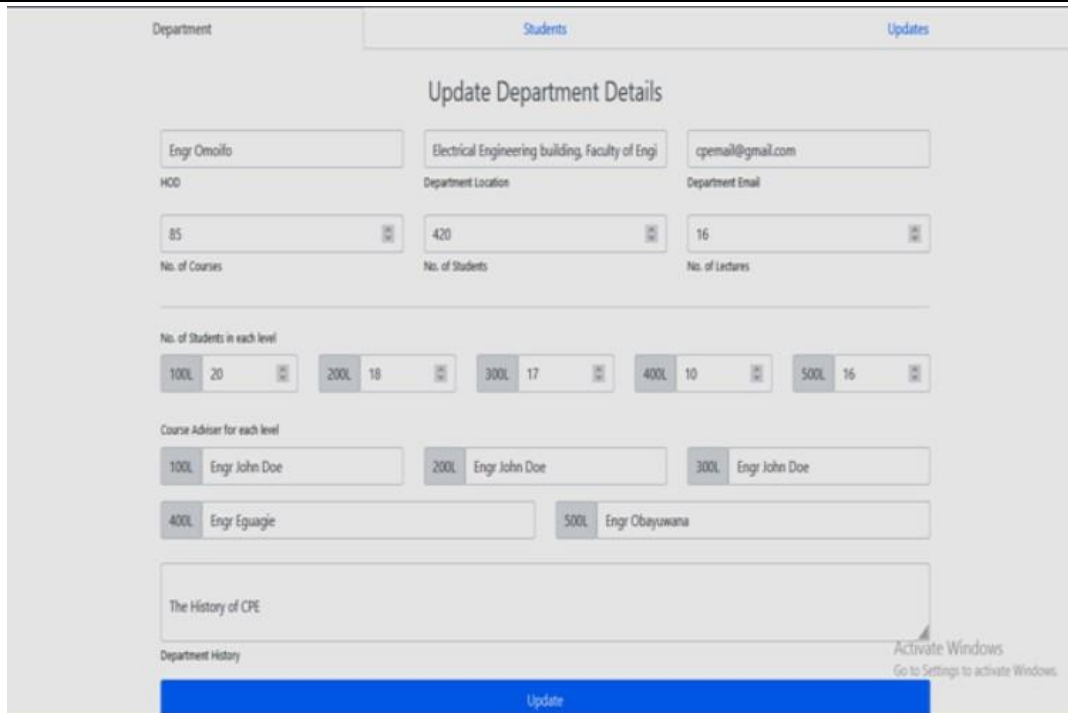


Figure 7: Admin portal

Testing the System

The bot was evaluated using several platforms namely Telegram, Messenger, and WhatsApp. The main platform used for testing is Telegram. After the configuration of the admin dashboard where information, questions, intents, and answers were generated. Telegram was used in training and evaluating the chatbot for accuracy and reliability. Having all the data required to train the chatbot, you create intents, which capture the questions users might ask about the Department. Then, you evaluate the chatbot by using a built-in simulator in Dialog flow.

If the chatbot system is unable to answer questions asked by the students, it sends a reply saying, “Sorry I didn't get that, can you rephrase?” or “Sorry can you say that again?”. After which, The questions are then recorded in the admin panel database.

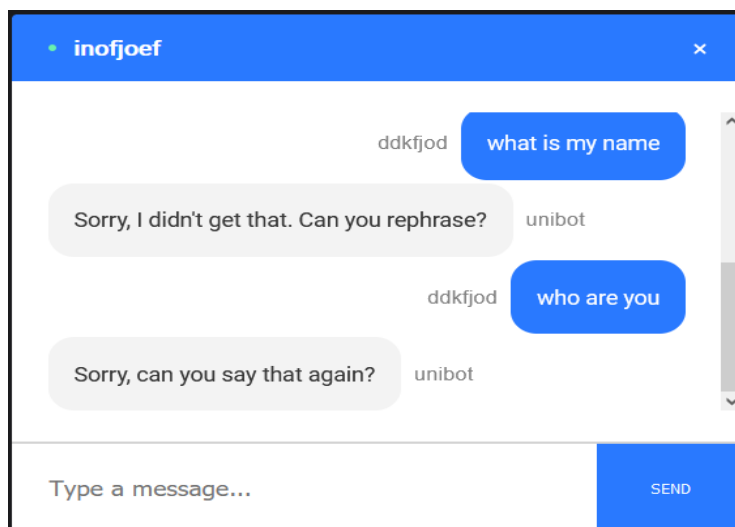


Figure 8: Unknown questions and response

IV. CONCLUSION

The main objective of the project was to develop an algorithm that would be able to identify answers associated with user-submitted questions. To develop a database where all the related data are going to be stored and to

develop an internet interface. The web interface developed had two parts, one for easy users and one for the administrator. Background research happened, including a summary of the conversation procedure and any relevant chatbots available. A database system was designed that stores information regarding questions, answers, keywords, logs, and feedback messages. A usable system was designed, developed, and deployed to the online server twice. An evaluation happened from data collected by potential students at the university. Also, after receiving feedback from the primary deployment, extra requirements were introduced and implemented. The system uses built-in artificial intelligence to answer the query. The answers are appropriate to the user's queries. The User can query any college-related activities through the system.

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