JAICOB: AI-POWERED DATA SCIENCE CHAT ASSISTANT

Dr P. Rama Koteswara Rao[1],N.Srikanth[2],B.Sai Surya[3],B.Udaykiran[4],D.Harikanth[5]
Professor, Department of Computer Science and Engineering[1]
Student, Department of Computer Science and Engineering[2,3,4,5]
[1,2,3,4,5]Sree Dattha Institute of Engineering and Science, Sheriguda, Telangana.

ABSTRACT

The integration of natural language processing (NLP) into educational information systems has proven highly advantageous for student interaction. Recent advancements in cognitive computing have introduced innovative ways to interact, facilitating quicker insights from existing data sources and enhancing the learning experience. This study explores the application of cognitive computing within blended learning environments. We propose a modular cognitive agent architecture designed for pedagogical question answering, enriched with social dialogue capabilities tailored to specific knowledge domains. Developed as a personal assistant, this system supports students in learning Data Science and Machine Learning techniques. Its implementation includes training machine learning models and refining natural language understanding algorithms within a user-friendly interface. The system's efficacy has been verified through experimental validation.

Index Terms: Natural Language Processing, Cognitive Computing, Blended Learning Environments, Pedagogical Question Answering, Social Dialogue, User-Friendly Interface, Machine Learning Models.

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I.INTRODUCTION

Cognitive computing has grown in the last few years, increasing the research and commercial interest in the topic. Conversational agents have evolved from simple pattern-based programs into rather complex systems, including Natural Language Understanding and Machine Learning Techniques, which have allowed them to be more flexible in maintaining a conversation. Every day more businesses include chatbots as a way to interact with consumers to answer requests and FAQs. Natural Language Interface (NLI) increases user satisfaction and can help to find the information needed in a more comfortable way than other less sophisticated and time consuming search interfaces. Like humans, cognitive systems can use their knowledge to deduce data meaning based on context. By having the advantage of computational power, a system like this can be even more successful than a human in this kind of task. Though they do not understand the meaning as humans do, the insights these systems provide can be beneficial. As they grow in time, it is expected that they gain abilities such as sensing and awareness.

Some of the benefits of the application of cognitive computing in the development of learning applications are:

(1) They can actively enhance students' performances, especially in computer science classes;

(2) studying cognitive computing behavior can lead to significant results in educational applications, especially in AI-related studies;

(3) using a cognitive computing layer for digital interactions with students can enhance their performances and ease the teachers' job in managing classes and learning materials; and
(4) chatbots are excellent analysis tools, as students feel more inclined to send more messages to chatbots than real people .
Compared to other traditional e-learning training, chatbots generate a more positive response from the users. More over, there are advantages in this type of learning, such as interaction, active learning, and sociability. Despite these reasons, these technologies have not been widely adopted yet in education, and the ones that have are usually very rule-based and, therefore, less practical and functional. This article presents a modular architecture chatbot named Jaicob, adapted to the learning of Data Science techniques that aims to take advantage of all the benefits for education previously described. It is designed in a modular way that allows its adaptation to other areas of knowledge. It includes a flexible conversation workflow and is easy to maintain. This contribution has been evaluated with real users for a specific use case in a Data Science class.

II.LITERATURE SURVEY

- J. Hill, W. Randolph Ford, and I. G. Farreras proposed to analyze how communication changes when people communicate with an intelligent agent as opposed to another human. They compared 100 instant messaging conversations to 100 exchanges with the popular chatbot Cleverbot along seven dimensions: words per message, words per conversation, messages per conversation, word uniqueness, and the use of profanity, shorthand, and emoticons. A MANOVA indicated that people communicated with the chatbot for longer durations (but with shorter messages) than they did with another human. Additionally, human–chatbot communication lacked much of the richness of vocabulary found in conversations among people and exhibited greater profanity. These results suggest that while human language skills transfer easily to human–chatbot communication, there are notable differences in the content and quality of such conversations.
- M. Proctor, D. Mah, L. Jewell, and B. Cheung proposed a chatbot named Freudbot, constructed using the open-source architecture of AIML, to determine if a famous person application of chatbot technology could improve student-content interaction in distance education. Fifty-three students in psychology completed a study in which they chatted with Freudbot over the web for 10 minutes under one of two instructional sets. They then completed a questionnaire to provide information about their experience and demographic variables. The results from the questionnaire indicated a neutral evaluation of the chat experience, although participants positively endorsed the expansion of chatbot technology and provided clear direction for future development and improvement. A basic analysis of the chat logs indicated a high proportion of on-task behavior. There was no effect of instructional set. Altogether, the findings indicate that famous person applications of chatbot technology may be promising as a teaching and learning tool in distance and online education.
- H. Doan-Nguyen and L. Kosseim presented experiments in applying semantic information to improve the precision of the information retrieval module in a closed-domain question-answering system. This system aims to reply to questions on services offered by a large company, Bell Canada. Their approach consists of finding a set of special terms and building an ontological concept hierarchy, which can effectively characterize the relevance of a retrieved candidate to its corresponding question. Combining these two kinds of semantic information with the information retrieval module has resulted in significant improvements.

- Q. M. Nguyen, T. H. Nguyen, and T. T. H. Cao proposed that the application of automatic conversational systems (chatbots) in learning foreign languages is still limited. In this study, they built a chatbot dedicated to English learners. The system, named English Practice, is installed on mobile devices to interact with users through a chat window. The chatbot can automatically remind learners to study and suggest answers to multiple-choice questions. It also helps users in learning vocabulary and new lessons. The results show that most of the basic functions of the system are used by the users, indicating that this approach promises to be widely applied in the future.
- Iglesias, Á. Carrera, and A. Mardomingo proposed that the application of natural language to improve the interaction of human users with information systems is a growing trend in recent years. Advances in cognitive computing enable a new way of interaction that accelerates insight from existing information sources. In their paper, they propose a modular cognitive agent architecture for question answering featuring social dialogue improved for a specific knowledge domain. The proposed system has been implemented as a personal agent to assist students in learning the Java programming language. The developed prototype has been evaluated to analyze how users perceive the interaction with the system. They claim that including social dialogue in QA systems increases user satisfaction and makes them more easily engage with the system. Finally, they present the evaluation results that support their hypotheses.

III.EXISTING SYSTEM:

In existing systems, the application of natural language to enhance students' interaction with information systems has shown significant benefits. These systems leverage advancements in cognitive computing to introduce innovative interaction methods that streamline access to and extraction of insights from diverse information sources. By integrating natural language processing (NLP) capabilities, these systems facilitate a more intuitive and efficient learning experience.

Students can engage with these systems using everyday language, allowing them to pose queries, receive responses, and access information in a manner that mirrors human conversation. This approach not only accelerates the retrieval of relevant information but also fosters deeper understanding through interactive exploration of educational content.

IV.PROPOSED SYSTEM

The proposed system, "JAICOB: A Data Science Chatbot," aims to address several key aspects to enhance the interaction between students and information systems in the realm of blended learning. This system introduces a modular cognitive agent architecture specifically designed for pedagogical question answering within the domains of Data Science and Machine Learning. The innovation lies in its incorporation of social dialogue, or small talk, which fosters a more natural and engaging interaction for users. Unlike existing systems, JAICOB is intended to possess an improved understanding of the contextual nuances within its predefined knowledge domain. This entails not only answering direct questions but also engaging in more dynamic and context-aware conversations with users.

The system's design emphasizes modularity, allowing for flexibility and scalability in integrating various components such as natural language understanding algorithms, machine learning models, and a user-friendly interface. JAICOB's implementation involves the meticulous training of machine learning models to comprehend and respond to user queries effectively. The interface is crafted to simulate a human-like interaction, enhancing the overall user experience. As a unique feature, JAICOB focuses on assisting students in learning complex concepts in Data Science and Machine

Learning by tailoring its responses and guidance to the specific needs of learners.

To validate the effectiveness of JAICOB, an experimental approach has been adopted. This involves rigorous testing and evaluation to measure the system's accuracy, responsiveness, and overall educational impact. The results of these experiments will provide valuable insights into the system's performance, enabling iterative refinement and continuous improvement. Through these innovations, the proposed system envisions a more dynamic, context-aware, and user-centric approach to educational technology, contributing to an enriched learning experience in the field of Data Science and Machine Learning.

V.SYSTEM ARCHITECTURE

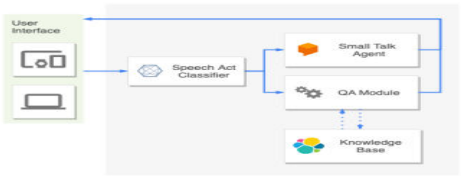

Figure 1.System Architecture

VI.IMPLEMANTATION

MODULES

Natural Language Understanding (NLU):

The NLU module is responsible for processing and comprehending user input in natural language. It involves techniques such as tokenization, part-of-speech tagging, and named entity recognition. JAICOB's NLU module aims to understand the intent and context of user queries within the specific knowledge domain of Data Science and Machine Learning.

Dialogue Management:

The Dialogue Management module orchestrates the flow of conversation and determines appropriate responses based on user input and the system's knowledge. It considers the context of the conversation, user history, and the goals of the interaction. This module in JAICOB ensures coherent and context-aware conversations, making the chatbot more effective in pedagogical question answering and small talk.

Machine Learning Models for Question Answering:

This module involves the implementation and training of machine learning models tailored for question answering within the domains of Data Science and Machine Learning. JAICOB utilizes these models to provide accurate and relevant responses to user queries. The models are trained on a diverse and representative dataset to enhance their ability to handle a wide range of questions.

User Interface (UI):

The User Interface module focuses on the design and presentation of JAICOB to the end-users, primarily students. It provides an intuitive and user-friendly interface, mimicking human-like interactions. The UI module contributes to the overall user experience by making the interaction with the chatbot more engaging and accessible, especially for learners who may be new to the subject matter.

Experimentation and Evaluation:

This module involves the setup and execution of experiments to validate the effectiveness of JAICOB. It includes metrics for assessing the accuracy of responses, user satisfaction, and overall educational impact. The experimentation module plays a crucial role in gathering empirical evidence to refine and optimize the system continually.

VII.RESULTS

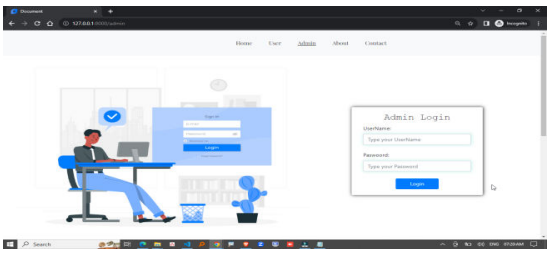

Figure 2 Main screen

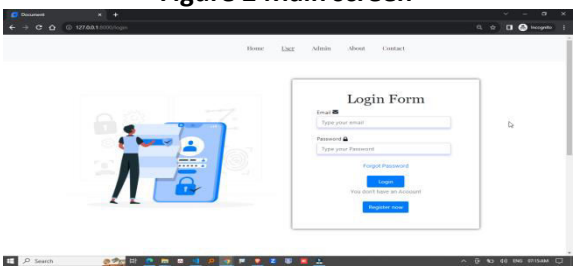

Figure 3

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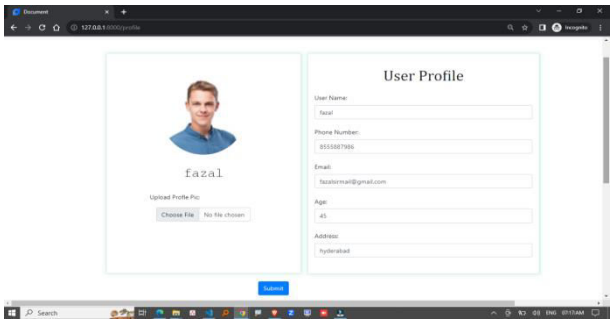

Figure 4

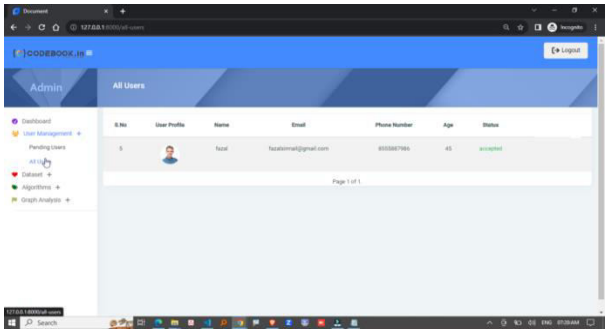

Figure 5

VIII.CONCLUSION

The use of chatbots has become prevalent in the last years in shopping, customer support, general assistance, and, though less developed, education. The use of chatbots as a form of e-learning brings lots of opportunities.

This article identified the advantages of cognitive assistants in education and the corresponding challenges in implementation. A result is a tool for students with a comfortable and usable interface and a human experience. It can provide insights and solve doubts about Data Science. The main contribution is the adaptation of students' real pedagogic needs to the design of the architecture and being flexible in maintaining a conversation.

Teachers can also use it as a tool to identify gaps in the knowledge of their students. They can also outsource to Jaicob the answering of all the questions. The pedagogue is also an excellent asset to select the most valuable sources of information from which Jaicob feeds from, thus providing a curated source of information instead of a regular Google Search.

The project was evaluated with a sample of students, achieving very favorable results in usability and originality. The experiment confirms that the system can answer effectively, that the answer accuracy affects the satisfaction, utilitarian value, and behavioral intentions of the user, and that proper social handling is significant in satisfaction and utilitarian value but not in behavioral intentions.

As these technologies evolve, more and more people will study these subjects. Therefore, the future impact of the project is promising, and the affected groups will increase.

IX.FUTURE ENHANCEMENT

In future work, to achieve a broader reach in the areas of knowledge, it is straightforward to place additional information in the Knowledge Base and the corresponding Dialogflow intents.

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