A Proposed Cognitive Framework Model for a Student Support Chatbot in a Higher Education Institution

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---**ABSTRACT**---
The proposed student support chatbot is a framework model that enables the discovery of theoretical and conceptual design. It is aimed at responding to students' frequently asked questions (FAQs) about pedagogical information, including course registrations, fees, exams, course assessments, grades, appeals against the grades, and anything related to students in a higher education institution (HEI). All the student-related information can be implemented as a real-time conversational system on the web or on a mobile platform of any HEI, such as institutional websites, mobile apps, or integrations with their social media like WhatsApp, Twitter, Facebook Messenger, or Instagram. This design intends to provide cognitive services by identifying the benefits, challenges, and various ways of implementation. Most students individually ask the same question repeatedly to their advisors and course lecturers, which could be discussed and explained earlier, in which the faculties are spending too much time responding to their advisees' or students' questions. The cognitive services include different languages for text-based, voice-based, and graphical user interface requests with sensitive as well as non-sensitive requests. Thus, a student support chatbot is recommended for any HEI to minimize the time spent repeatedly answering questions, and this helps the staff, advisors, and faculties utilize the time on other academic performance.

I. INTRODUCTION

Artificial intelligence (AI) is the intelligence processing of computer systems that is like human thinking. Conversational Artificial Intelligence (CAI) [1] is a technology that users can talk to, such as chatbots, AI chatbots, chatterbots, conversational agents, virtual agents, AI assistants, virtual assistants, and virtual humans. CAI utilizes huge amounts of backend storage, machine learning (ML), and natural language processing (NLP). NLP accelerates computers' recognition of human dialects. NLP can recognize text and spoken words just like humans, translate text from one language to another, answer voice commands, and encapsulate huge amounts of text quickly.

Natural Language Understanding (NLU) understands the meaning of the text input by the user. However, if the input is a voice message, a combination of Automatic Speech Recognition (ASR) and NLU will analyze the message, while Natural Language Generation (NLG) produces understandable texts in human words. NLU and NLG are part of NLP [1]. Cognitive services are a set of ML algorithms developed to solve problems in AI. The cognitive service is supported by digital automation and AI.

Instant messaging programs are commonly implemented to communicate and exchange information. It can be part of an organizational automation process like customer service, sales, and human resources. A chatbot2 is a program that responds to the requests of a computer user. The conversation might occur through voice instructions, text messages, or graphical input. Chatbots will take the user's requests and give a fast response, rather than manually searching for an enormous list of frequently asked questions (FAQs). A FAQ provides a list of questions with their answers concerning a particular subject. Chatbots are used in countless businesses to convey information or product details and accomplish many tasks. These chatbots are also used by social media applications related to the concern, such as Telegram, Facebook Messenger, WeChat, Twitter, and Instagram.

Since chatbots can provide real-time customer support 24/7 in any business, they have rarely been used in higher education institutions for students' needs. Higher Education Institutions (HEIs) are government or private establishments for the teaching and learning process and carrying out research. It honors academic degrees or certificates through universities, colleges or educational institutions, institute of technologies, and other collegiate-level institutions.

Student support services are all the services provided by the educational institution to facilitate the student's success at the learning institution. It refers to all services, academic and non-academic. Commonly, the purpose of an academic-related student support chatbot can moderate the effort of the faculty or staff but also clarify the

enquiries by responding to pedagogical information, including course registrations, fee structures and balances, course advising and prerequisite courses, course assessments and related procedures, exam schedules, and grades. In addition,student supportchatbot can significantly reduce the number of advising and consultation hours offered by those faculties or staff during working hours as well as during non-working hours.

The reason behind this model chatbot is that most of the time, faculties are engaged in academic work, and staff are focused on non-academic tasks such as student support services. Students' support is the need for the students to have peer tutoring, supplemental instruction, and academic counselling related things like stress management, developing language skills, exam preparation, and knowing their personal details. Even though some non-academic tasks are placed on faculty members' desks, this reduces their performance in terms of teaching quality, problem solving, and research skills.

The significance of the model in higher education institutions helps all faculties, staff, and students in reducing repeated queries. The hypothesis of the model focuses on both academic and non-academic services, and the data requested can be sensitive or non-sensitive. The students can request it either in text chat or voice message. The chat text can be in English or in their native or national language.

II. STATEMENT OF PROBLEM

Students would be thinking about their academic and non-academic concerns at any time, meaning during working days and times as well as non-working days and times, 24x7, since they require support from faculties and staff of higher education institutions. The services expected by the students can be academic-related information, including the registration details of any courses with their prerequisites, the remaining courses from the student's advisor, fee-related from the financial accountant, psychologically-related issues from the counselling coordinator, library-related, job placement related, clarifying doubts about courses, their assessments and related procedures from faculties, and exam-related information such as term exam schedules, clashing exams, supplementary exams, grades, and student appeals related from the exam coordinator.

Most of these services are already offered through its institutional website, which includes its FAQs, student portal, college information management system, and eLearning portal, with all the course contents and assessment procedures given in the delivery plan. And the information dissemination might be done across social media accounts such as Twitter and Instagram. However, a few institutions only have chatbots on their websites and social media platforms, but not all institutions. At the same time, most of the chatbots are implemented to provide non-sensitive data.

Still, the student may require clarification or advice from the relevant faculty or staff. It happens due to students not paying attention to their faculties or staff, or not understanding institutional procedures and policies. Most students individually ask the same question repeatedly without understanding their advisors and course lecturers, which could be discussed and explained earlier, in which the faculties are spending too much time responding to their advisees' or course students' questions. Thus, student support chatbot is recommended to any HEI to minimize the time spent frequently answering questions with extended ways to show even more sensitive information by authenticating the students, and this helps the faculties and staff utilize the time on other academic activities. There are chatbot services provided in the cloud by Amazon, Microsoft, Google, IBM, etc. They provide rule-based and AI-based chatbots with NLU processing, but they cannot connect with the internal storage of any HEI systems.

2.1 Scope and limitation

The scope of the proposed model for designing student supportchatbots can provide both sensitive and non-sensitive data. The request from the students can be a text message, a voice message, or a graphical user interface. All the faculties and staff of a higher educational institution can be minimized by providing repeated non-academic and academic services while also extending other activities such as improving teaching qualities and materials, focusing on research conferences or events, and publishing related works. The student support chatbot may be limited to accessing the accounts of specific students from their college information management system, student portal, college information management system, and eLearning portal to the student support chatbot system and keeping the student support chatbot system ready and updated all the time.

III. LITERATURE REVIEW

Bhavika R. Ranoliya et al. [3] created a chatbot for university correlated FAQs using AIML, which was based on the observation of ELIZA and ALICE. Similarly, Madhumitha.S et al. [4] conducted a comparative review of AIML and ChatScript, as well as features of popular bot creation and distribution services.Vishal R. Shinde et al. [5] reviewed and compared existing chatbots for college-related FAQs and designed them to adapt the model of Bhavika R. Ranoliya et al. [3]. Indhu.G, et al. [6] used chatbots for student information and used the ANN algorithm to analyze the comparative and intelligent answers.

Shang-Pin Ma and Ching-Ting Ho [7] developed a flow-based chatbot model with two main features. The first is a visual flow-based for the design and deployment of chatbots; and the second is a recently planned data format for service webhook. Also, they compared it with RedBot and api.ai. Massimo Canonico& Luigi De Russis [8] and

Graciane X. Nobre et al.[9] compared the NLU platforms, and their results are shown in Table 1.

Table 1. NLU platform on cloud services.

Platform	Uses	Languages	Programming Languages	Online Integration	Price
Dialogflow	High	15	11, from Java to Ruby	14, from Telegram to Alexa	Free
wit.ai	Medium	50	3: Node.js, Python, and Ruby	Zero	Free, contact heavy usage
LUIS	Medium	10	4: Android, Python, C#, and Node.js	Zero	Free up to 10k requests per month
Watson Conversation	High	12	6, from Node.js to Java	Zero	Free up to 10k requests per month
Amazon Lex	Low	English	9, from Java to Go	3: Twilio SMS, FB Messenger, Slack	Free for the 1st year (with limits)
Recast.ai	Medium	16	7, from Python to Go	Zero	Free

Neelkumar P. Patel et al. [10] designed a Unibot that has a Graphical User Interface (GUI) design with HyperText Markup Language (HTML) and Cascading Style Sheets (CSS). It gets a response from a PHP file, while jQuery responds to the messages sent to the user. This Unibot responds with information such as academic events, admission process and fee details for any degrees, university information, departmental prospectus, class schedules, important notices, and so on. NahdatulAkma Ahmad et al.[11] developed the UNISEL Bot using widgets, JSON, PHP, and MySQL. This bot supported the marketing department in a smarter and more interactive way by receiving FAQs from students and providing responses.

Graciane X. Nobre et al. [9] used DialogFlow to create conversational agents quickly and integrate them with Telegram. NLP processed sentences were added to the system. The DialogFlow, also known as api.ai, is built on Google's cloud-based platform based on NLU. It combines Google's ML algorithms and supports integrations with Telegram, Facebook Messenger, Twitter, and Skype, among other apps. J.Jinu Sophia[12] also used DialogFlow to create EDUBOT-A Chatbot, which provided integrations with Telegram, Messenger, Slack, and so on. It also made comparisons with Visual Dialog and Cloud CV.

Naing NaingKhin&Khin Mar Soe [13] designed a university chatbot using AIML that supports the Myanmar language. B. Arunkumar [14] designed a chatbot using AIML on the Python platform. Lala Olusegun Gbengaa et al. [15] created a model for a university admission enquiry system. This chatbot responds to university admissions-related enquiries using an artificially intelligent platform by IBM Watson.

Gwendal Daniel et al. [16] proposed Xatkit, which is open source and accessible online at https://xatkit.com/chatbot-examples. It integrates Xatkit with low coding to create the full software requirements as part of their user interface. Gwendal Daniel & Jordi Cabot [17] also identified software challenges in building smart chatbots on Xatkit. Debmalya Biswas [18] used chatbots with privacy-preserving chatbot conversations, which sent and received encrypted messages.

Godavarthi Sri Sai Vikas et al. [19] created a web chatbot using HTML and CSS. It allows chatting by filling in personal details and is designed to know the cutoff ranks for admissions or for any events. E. Kasthuri and Dr. S. Balaji [20] created an educational chatbot for students who have questions about the lab manual using a deep learning method. The bot responds to the student's questions.

Chinedu Wilfred Okonkwo [21] reviewed current literature on the use of chatbot systems in education by asking four different questions, which identified the arrangements of earlier understandings on the applications of chatbots in the educational sector. William Villegas-Ch et al. [22] used an AI chatbot in such a way that the information about training courses was addressed, reducing the administrative burden, and improving the student's experience.

Claudia de Armas de Armas et al. [23] did a comparative study, which is shown in Table 2. It is a cloud platform, and its services include Amazon Web Service, Google, and Microsoft. This is designated to be completed and made possible according to their needs by evolving an Intelligent Virtual Assistant (IVA). It enabled interaction through text and user voice. V. Prathyusha et al. [24] reused the downloaded EchoBot template and modified using Visual Studio. This chatbot responds the user's questions regarding college information and integrated in the Skype.

Athira Susan George et al. [25] reviewed chatbots used in different Indian languages to bridge the communication gap amongst Indian users. It is also reviewed by multilingual chatbots such as Aham, COVID-19 self-help chatbot, Niki, and Recharge Bot by Payjo. It is identified as the platforms that support multilingual chatbots, such as vernacular.ai, dhee.ai, haptik, and flow.ai.

Table 2. Contrast of the cloud services by criteria.

Criteria	Cloud Services		
	Amazon	Microsoft	Google
Machine Learning	AWS ML Amazon Sage Maker	Azure ML Studio Azure ML Services	AI Platform Cloud AutoML
Language Processing & Speech Recognition AI	Amazon Comprehend Lex Polly	QnA Maker Language Understating (LUIS) Text Analytics Speech to Text	Dialogflow Natural language API Cloud Speech API
Image Recognition AI	AWS Rekognition	Azure Cognitive Services	Cloud Vision API

Most of the research findings and reviews on creating their own chatbots use the following programming technologies: frontend HTML, CSS, jQuery, Ajax, JSON, PHP, Java, Python, Visual Studio, and the backend like MySQL. These designs and implementations were done either by downloading the chatbot template or by integrating Artificial Linguistic Internet Computer Entity (AIML), which was based on the observation of ELIZA and ALICE. On the other hand, AI chatbots are created using cloud services, which provide an NLU platform on cloud services. The chatbot template is also provided on the NLU platform. It provides smooth implementation, simple customization, wide choice, and integrations with the most popular platforms, saving time and costs. Chatbots not only respond to the information from databases but are also customized with AI to bring recommendations based on the user's input.

IV. RESEARCH METHODS

Chatbots are prepared with list of FAQs with its responses, artificial intelligence, or both. There are two main types [2]: rule-basedand AI chatbots. Rule-based chatbots or linguistic-based chatbots communicate using predefined answers, whereas AI chatbots are greatly improved than rule-based, which has ML, NLP, and sentimental analysis. This research proposed a model for designing a student support chatbot in the HEI, which can be carried out in a theoretical and conceptual design. This research proposed a model for designing a student support chatbot that addresses how to deal with non-sensitive and sensitive student user requests.

3.1. Prepare student support chatbot model FAQ list

FAQs are the foundation of the conversational AI development process. It helps us to define the main needs and concerns of our students. Hence, we must determine and prepare the appropriate questions that our conversational AI can assist with. The FAQ can be prepared based on the nature of the question, either sensitive or non-sensitive. Each category is again divided based on the nature of the task. Every task will have questions with one or more answers. For example, our list of FAQs shown in the Table 3.

Table 3. Student Support chatbot model FAQ list.

Categories	Task Related	Questions	Answers1	Answers2	Answers 3,…
Sensitive	Fees	How much fee balance do I have for this semester?	You have a remaining balance 1000$	You paid 1000$	Total fees 2000 $
	Advising	What is my CCGP?	Your CGPA is 3		
	Advising	What courses do I have left at this level of study?	Course 1	Course 2…	…
	Advising	What are the ramifications if I fail a course again?	It will affect CCPA		
	Exam	What is my grade or result for all my courses this semester?	Course 1 - A	Course 2 - B…	…
	Exam	What is my supplementary exam result?	Course 1 - B	Course 2 - A…	
	Job placement	When will I complete the job placement letter?	Once completed the placement training		
	Exam	When will I receive my certification?	Once you completed the 2 remaining courses		
Non-Sensitive	Admission	When will the class begin?	On September first week		
	Procedures and policies	What is the procedure to drop the course?	You are allowed to drop only one course in a semester within one week, after the result announcement		
	Procedures and policies	What is the policy for exam appeals?			
	Department	What are the specializations offered in the IT department?	Software, Networking Security		
	Event	When will the poster presentation be?	On December 20		
	Library	Is the book Calculus available?	yes		
	Exam	when will the final exam begins?	End of December		

3.2. Student Support Chatbot Framework Model

The proposed framework model is given in Figure 1. The student support chatbot shows NLP components, so this chatbot can be an AI chatbot. For instance, if you don't need any language processing, we can remove NLP

components from the framework that will work as a rule-based chatbot. The student support chatbot message can be given either from a computer or laptop or from mobile devices. The input can be text, voice, or graphical option-based input. The inputs are initially validated to be classified as either sensitive or non-sensitive. If the message inputs are sensitive, then it will require a login through institution credential. The student support chatbot will connect with data storage to answer the question if there is any voice message that can be processed in the NLP components. The privacy and security aim to maintain authenticated sessions, input messages and respond messages travelling over the network in the form of encrypted messages.
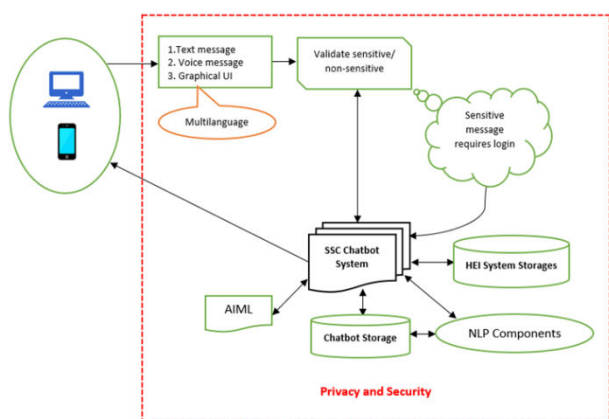

Fig. 1. Student SupportChatbot Framework Model.

Sensitive data may be present not only in the actual data storage, but mostly it presents in the HEI information management, student appeal system, library management system, eLearning system, etc. The conceptual framework shown in Figure 2 illustrates the need for authentication session. Implementation of this model can be done through any desirable frontend and backend technologies or integration with AIML.
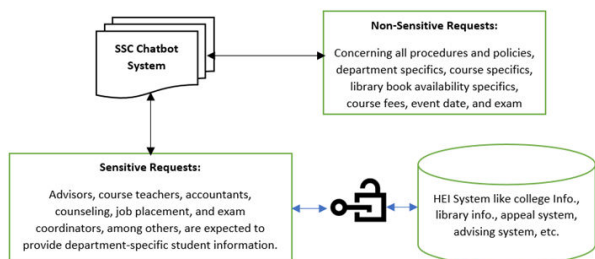

Fig. 2. Student SupportChatbot Conceptual Framework

V. DISCUSSION AND FUTURE RESEARCH

As a summary of this research suggests, this framework model carried the design consideration of a student support chatbot for any HEI. This framework model is intended to design a chatbot with multilingual support. The student's user input can be in the form of text, voice, or graphical user interface interactions. This chatbot

motivates researchers to include student requests with sensitive as well as non-sensitive data. Hence, this chatbot can be a hybrid chatbot since it is focused on rule-based as well as AI-based chatbots. It is designed to access the internal storage of the HEI. There are chatbot cloud services provided by Amazon, Microsoft, Google, IBM, etc. However, they cannot connect to the internal storage of any HEI systems.

As the conclusion of this research suggests, there is a way to choose what kind of technique or technology we are going to use. It all depends on the programming knowledge and experience we have and how complex our chatbot is going to be. Selecting the right platform depends on our time, knowledge, and budget. This model is recommended for any HEI to minimize the time spent on repeatedly answering questions, most importantly for sensitive questions as well as non-sensitive questions. The proposed student support chatbot framework model will help the faculties, staff, supervisors, and advisors avoid excessive response to the students and achieve excellence in their academic performance.

REFERENCES

[1] IBM Cloud Education, Conversational AI (2020), https://www.ibm.com/cloud/learn /conversational-ai.

[2] LiveChat Inc, Chatbot Guide (2021), https://www.chatbot.com/ chatbot-guide.

[3] Bhavika R. Ranoliya, Nidhi Raghuwanshi and Sanjay Singh, Chatbot for University Related FAQs, International Conference on Advances in Computing, Communications and Informatics, 2017, pp. 1525-1530, doi: 10.1109/ICACCI.2017.8126057.

[4] Madhumitha.S, et al. Interactive Chatbot Using AIML, Special Issue Published in Int. Jnl. Of Advanced Networking & Applications (IJANA), 217-223, https://www.ijana.in/papers/62.pdf.

[5] Vishal R. Shinde et al. Chatbot for college related FAQs, International Journal for Research in Engineering Application & Management, (2019) 31-35, issn: 2454-9150.

[6] Indhu.G, et al. Chatbot for Student Information, Special Issue Published in Int. Jnl. Of Advanced Networking & Applications (IJANA),31-33, https://www.ijana.in/papers/11.pdf.

[7] Shang-Pin Ma & Ching-Ting Ho, Modularized and Flow-Based Approach to Chatbot Design and Deployment, Journal of Information Science and Engineering 34 (2018), ISSN: 1187-1201, doi: 10.6688/JISE.201809_34(5).0005.

[8] Massimo Canonico & Luigi De Russis, A Comparison and Critique of Natural Language Understanding Tools, Cloud Computing, The Ninth International Conference on Cloud Computing, GRIDs, and Virtualization, (2018).

[9] Graciane X. Nobre et al., A Chatbot Approach to Automating FAQ Responses in an Undergraduate Course Domain, (2019),

http://www.repositorio.ufc.br/bitstream/riufc/55127/1/ 2019_tcc_gxnobre.pdf.

[10] Neelkumar P. Patel et al., AI and Web-Based Human-Like Interactive University Chatbot (UNIBOT), Third International Conference on Electronics Communication and Aerospace Technology, (2019) 148-150, isbn: 978-1-7281-0167-5.

[11] NahdatulAkma Ahmad et al., UNISEL Bot: Designing Simple Chatbot System for University FAQs, International Journal of Innovative Technology and Exploring Engineering, 9 (2019) issn: 2278-3075.

[12] J.Jinu Sophia &T.Prem Jacob, EDUBOT-A Chatbot For Education in Covid-19 Pandemic and VQAbot Comparison, Second International Conference on Electronics and Sustainable Communication Systems (2021), doi: 10.1109/ICESC51422.2021.9532611.

[13] Naing NaingKhin&Khin Mar Soe, University Chatbot using Artificial Intelligence Markup Language, IEEE Conference on Computer Applications (2020), doi: 10.1109/ICCA49400.2020.9022814

[14] B. Arunkumar, Development of Chatbot Automation Application – DGCT CSE ALEXA, International Research Journal of Engineering and Technology 07 (2020) 4498-4501, p-ISSN: 2395-0072.

[15] Lala Olusegun Gbengaa et al., An Improved Rapid Response Model for University Admission Enquiry System Using Chatbot, International Journal of Computer 38 (2020) 123-131.

[16] Gwendal Daniel et al. (2020) Xatkit: A Multimodal Low-Code Chatbot Development Framework, doi: 10.1109/ACCESS.2020.2966919.

[17] Gwendal Daniel & Jordi Cabot, The Software Challenges of Building Smart Chatbots, 43rd International Conference on Software Engineering: Companion Proceedings (2021), doi: 10.1109/ICSE-Companion52605.2021.00138.

[18] Debmalya Biswas, Privacy preserving chatbot conversations, IEEE Third International Conference on Artificial Intelligence and Knowledge Engineering (2020), doi: 10.1109/AIKE48582.2020.00035.

[19] Godavarthi Sri Sai Vikas et al., Information Chatbot for College Management System Using Multinomial Naive Bayes, 2nd International Conference on Smart Electronics and Communication (2021), doi: 10.1109/ICOSEC51865.2021.9591757.

[20] E.Kasthuri and Dr.S.Balaji, A Chatbot for Changing Lifestyle in Education, Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (2021) 1317-1322, doi: 10.1109/ICICV50876.2021.9388633.

[21] Chinedu Wilfred Okonkwo and Abejide Ade-Ibijola, Chatbots applications in education: A systematic review, Computers and Education: Artificial Intelligence 2 (2021), doi: 10.1016/j.caeai.2021.100033.

[22] William Villegas-Ch et al., Implementation of a Virtual Assistant for the Academic Management of a University with the Use of Artificial Intelligence, Future Internet 13 (2021), doi:10.3390/fi13040097.

[23] Claudia de Armas de Armas et al., Cloud-based ecosystem proposal for applying an intelligent virtual assistant in online education, 2nd Sustainable Cities Latin America Conference (2021), doi: 10.1109/SCLA53004.2021.9540099.

[24] V.Prathyusha et al., Information Acquisition Chatbot System using LUIS, Sixth International Conference on Inventive Computation Technologies, 6th International Conference on Inventive Computation Technologies (2021). doi: 10.1109/ICICT50816.2021.9358531.

[25] Athira Susan George et al., Survey on the Design and Development of Indian Language Chatbots, International Conference on Communication, Control, and Information Sciences (2021), doi: 10.1109/ICCISc52257.2021.9484891.

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