

DEVELOPMENT OF AN INTELLIGENT CONVERSATIONAL AGENT TO IMPROVE CARE AND SERVICES AT THE POLYTECHNIC UNIVERSITY OF SANTA ROSA JAUREGUI

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Summary

This document describes the construction of Denisse, a chatbot replicable in technological universities used in a case study to improve services in the physiotherapy clinic of the Polytechnic University of Santa Rosa Jáuregui. It is an informative chatbot that answers the most frequently asked questions from users of this clinic. This chatbot makes use of Javascript tools and framework using node.js as its execution environment. The information that is stored in a knowledge base is what allows the processing of keywords to understand the user's choices and to be able to generate appropriate responses. Data and user opinions are collected using SQL in order to consult and analyze the data. A service-oriented architecture is used, which allows the use of Whatsapp, with this the user is allowed to have a short learning curve.

Keywords: Chatbot, intelligent conversational agent, artificial intelligence for educational services.

I. INTRODUCTION

In today's digital age, the use of artificial intelligence has revolutionized the way we interact with computers and online services. Among the most notable advances is the creation and development of chatbots, which are automated conversational systems that use Natural Language Processing (NLP) and machine learning so that users interact efficiently and effectively helping to solve their concerns.

"On the educational level, there are universities that provide a virtual scenario to support face-to-face classes. The virtual campus is a very important teaching environment, although it often does not have dynamic tools to respond to students. The conversational agent can solve this problem, responding to the needs of the students in a direct interaction." (Rodríguez, 2021).

The ability of these chatbots to respond quickly, provide adequate information at the right time, and the personalization of services makes them a valuable tool for organizations and companies that seek to improve the experience of their users, as well as optimize their operations.

One of the most outstanding advantages of the chatbot is that it can help students individually with personalized attention. In universities, where large population groups are catered for, it is especially useful, even for massive courses that are available online. In the case of higher education, a chatbot can be trained from a wide variety of resources ranging from learning experiences to learning materials. Main trends in learning support that chatbots are addressing the following points:

- Chatbots work as an optimal learning method by repeating previous lessons, in case the student forgets it. With the support of these chatbots, after a reasonable time, previous lessons are repeated to maintain knowledge, preventing the student from forgetting it, in order to support learning.
- The chatbot can collect valuable information about the feedback of a course, the information that is collected is valuable to provide feedback and improve teaching and learning.
- Chatbots are capable of answering common questions about studying a topic, which motivates learning by making it faster and more convenient.
- Students constantly need administrative support to be able to carry out their procedures in a timely manner, that is why it is necessary to have the support of this type of chatbots that give them support for the registration process, payment dates, exam calendar, grades, tasks, schedules, services, among many others. By automating responses through the chatbot, there is a considerable workload for the administrative departments in the school, reducing resolution time.

This paper presents a case study that explores the chatbot environment, considering its architecture, its design and the approach used for its construction, analyzes its theoretical framework, as well as the benefits to the community, the practical applications that they can bring not only in environments but also in industry. In the case of the chatbot of this research, it is informative for the Physiotherapy Clinic of the Polytechnic University of Santa Rosa Jauregui, since it seeks to answer the most frequently asked questions of its users. The ethical considerations associated with design are also addressed, since it is important to guarantee the privacy and security of users, all this as part of the challenges of a chatbot.

In the article "Online chat and chatbots to enhance mature student engagement in higher education" by Noorhan Abbas it is mentioned; "Examples of service-oriented chatbots are those that answer students' questions about schedules, grades, tutors, societies, clubs, etc., such as Ask L.U. (Lancaster University, 2019)."

There are other service-oriented chatbots, such as Differ that helps students who have doubts about the services offered by universities, even introduces new classmates to the community, thus promoting participation.

BACKGROUND

"A chatbot is a conversational agent that interacts with users using natural language" (AbuShawar & Atwell, 2015). Chatbots have many uses for natural human-computer interaction (Abu Shawar & Atwell, 2007); In most Western countries, online chat platforms and chatbots are increasingly being used in higher education to boost student engagement and academic achievement (Pérez 2020).

A chatbot is an artificial intelligence program or also called conversational trees, designed to interact with users through conversations in natural language, either written or spoken. Its main purpose is to simulate a human conversation and provide coherent and relevant answers to users' questions or queries.

Chatbots use technologies such as Natural Language Processing (NLP) and Machine Learning to understand user queries, analyze the context of the conversation, and generate appropriate responses. Some chatbots are rule-based, meaning they follow a predefined set of instructions to respond to specific inputs, while others use advanced, data-trained language models to generate more flexible and contextualized responses.

User Interaction and Experience

The chatbot must be able to understand questions in everyday language and provide clear and precise answers to users. In addition, to facilitate navigation and improve the user experience, it is feasible to consider the possibility of implementing visual elements, such as buttons or cards in order to design a friendly and natural conversational interaction.

For this "OpenAI ChatGPT is considered a powerful technology with potential applications in social media, including customer service automation, content development, chatbots, sentiment analysis, and data collection." (Önden, 2023).

Ensuring compliance with data protection regulations and policies and offering a clear choice for users to understand how their data will be used should be done in order to ensure the security and privacy of user data.

II. METHODOLOGY

For the development of this project, the Scrum framework was used since, throughout the project, incremental product deliveries were made after adapting the changes based on the feedback obtained from the product owner's tutor. To help in the flow of tasks, the online tool Miro was used, which is free and allows you to record the movement of tasks through the Scrum board.

Scrum is employed as a framework for product development, with the primary purpose of generating finished and usable products that bring significant improvements to the final product. These advances are presented as deliverables at the conclusion of each Sprint.

In this project, the prototyping technique was adopted, which facilitated a better organization of the stages of the development process. A set of design specifications focused on the chatbot architecture was developed. The prototype was divided into increments, which were developed within the Sprints, with the aim of achieving significant improvements in the product. At the end of each Sprint, the incremental progress developed for each component of the prototype was delivered, and these were evaluated by the Scrum Master according to their disposition.

Here are the topics for each revised Sprint:

1. Gathering requirements with users of the clinic, students and applicants.
2. Analysis of the content of the subject for the construction of the knowledge framework.
3. Technical analysis of the chatbot type.
4. Chatbot engine implemented in Node.js with the tools analyzed.
5. Creating conversational trees in the selected frameWork.
6. Implementation of conversational trees in the selected frameWork.
7. WhatsApp interface connected to the chatbot engine via an API.
8. Differentiation of environments for the three types of established users.
9. Information on the subject stored in a relational database.
10. Notification process via ICS, indicating that the information is on a platform.

Based on the aforementioned Sprints, the following key features were developed for the development of the chatbot. The ChatBot will be implemented on the institutional website so that people inside and outside the institution who want career information can access, who will be the target audience.

Description of the role of the actors in the system:

1. General User:

- a. Consult academic information: Anyone can consult academic information such as: class schedules, school services, location, queries, help and frequently asked questions.
- b. Schedule appointments (Physiotherapy Area): The general user will be able to schedule and schedule appointments for the physiotherapy area.
- c. Request contact information: The user can request the contact number for the physiotherapy area.
- d. Location: The user will be able to check the location of the university with specifications if necessary.
- e. Check class schedules: The user will be able to check class schedules quickly and efficiently.
- f. Help and frequently asked questions: The user will be able to see the most frequently asked questions by other users, they will also be able to see the word "help" where they will see how the chatbot is used and thus ask their questions properly.
- g. School Services: The user will be able to consult the number and schedules of the school services department.

2. Administrative Staff (ChatBot)

- a. Schedule appointments (Physiotherapy Area): The ChatBot will be able to schedule appointments as users register.
- b. Request contact information: The ChatBot will be able to request the contact user's information, for example, their phone number and email and full name.
- c. Help and frequently asked questions: The ChatBot will be able to launch frequently asked questions made by other users, it will also send the word "help" in case the user needs any guidance with the system. One of these frequently asked questions may be the one that answers users' doubts.



Figure 1. UML use case diagram. Source: Own elaboration

III.RESULTS

According to Eleni Adamopoulou, creating a chatbot starts with planning the user's goals, procedures, and requirements. From there, the chatbot is developed using a programming language or chatbot development platform, and then the chatbot's functionalities are tested locally. The chatbot is then published to a website or data center and connects to one or more channels to send and receive messages. At this point, the proper integration of a chatbot into an application is crucial, and there are three methodologies to do so: API integration, manual integration, or third-party integration. Finally, the assessment is carried out by collecting data for a stipulated time after implementation so that developers can detect errors and use the data provided for feedback in order to improve the chatbot's performance and capabilities.

Component Model

To build a chatbot system for a university, a combination of different software components is required for the chatbot to work effectively and provide an optimal user experience. The main software components are:

1. **Chatbot development platform:** It is the core of the system, it provides the environment to create, train and deploy the chatbot. It can be a specific chatbot platform such as Dialog Flow, Microsoft Net Framework, IBM Watson Assistant, Raza, etc.
2. **Natural Language Processing (NLP):** NLP is essential for understanding and processing human language. It includes techniques such as entity recognition, sentiment analysis, identification of intentions, among others. These techniques allow the chatbot to understand and respond appropriately to user questions and requests.
3. **Knowledge base:** A ChatBot for a university must have access to an up-to-date knowledge base that contains relevant information about the institution, courses, academic programs, events, schedules, locations, among other important data.
4. **Integration with existing systems:** The chatbot should be able to integrate with pre-existing university systems, such as databases, student management systems, academic information systems, etc. This allows the chatbot to access up-to-date information and provide accurate answers.
5. **User interface:** The chatbot needs a friendly user interface so that students, professors, and university staff can interact with it easily. It can be implemented as a chat on a web page, a mobile app, or even through messaging platforms like Facebook Messenger or WhatsApp.
6. **Social media and website integration:** The chatbot can be deployed to answer questions and provide assistance on the university's social media and website, improving user experience and accessibility.
7. **Security and privacy:** Since chatbots can handle sensitive information, it is important to implement security and privacy measures to protect user data and ensure compliance with privacy regulations.
8. **Machine learning capabilities:** An intelligent chatbot can improve its performance over time using machine learning techniques, allowing it to adapt to changing patterns of questions and answers and improve the accuracy of questions.
9. **Metrics and analytics:** Incorporate analytics and tracking tools to evaluate chatbot performance and make data-driven improvements.

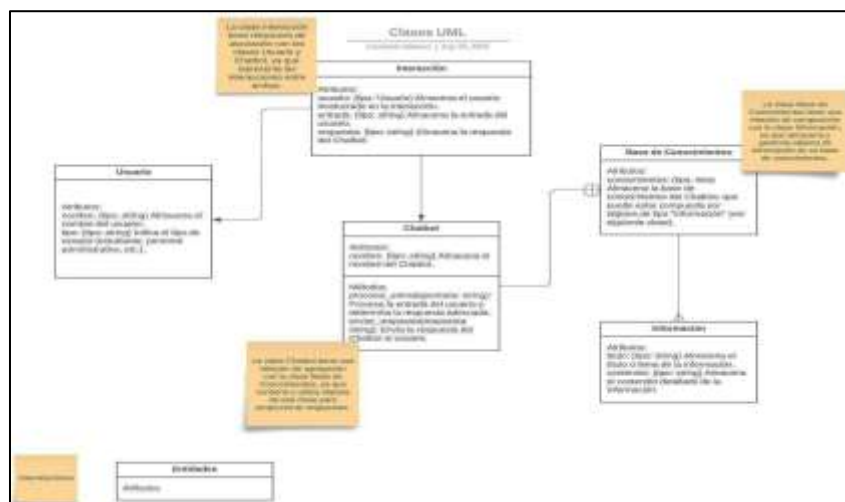


Figure 2. UML class diagram. Source: Own elaboration

Architecture.

Service-Oriented Architecture (SOA) is a software development method that uses software components called services to create business applications. Each of these services provides an entrepreneurial capacity and, in addition, they can also communicate with the rest of the services through different platforms and languages.



Figure 3. Data Architecture. Source: Own elaboration

Developers use services in different business processes to save time and money. They can build applications in less time with SOA instead of writing code and running integrations from scratch. It's easier to create, update, and fix bugs in small services than it is in large blocks of code in monolithic applications. Modifying a service in SOA does not affect the overall functionality of the business process. SOA is better adapted to technological advances. You can modernize your applications efficiently and cost-effectively. For example, healthcare organizations can use the functionality of older electronic health record systems in cloud-based applications that are newer.

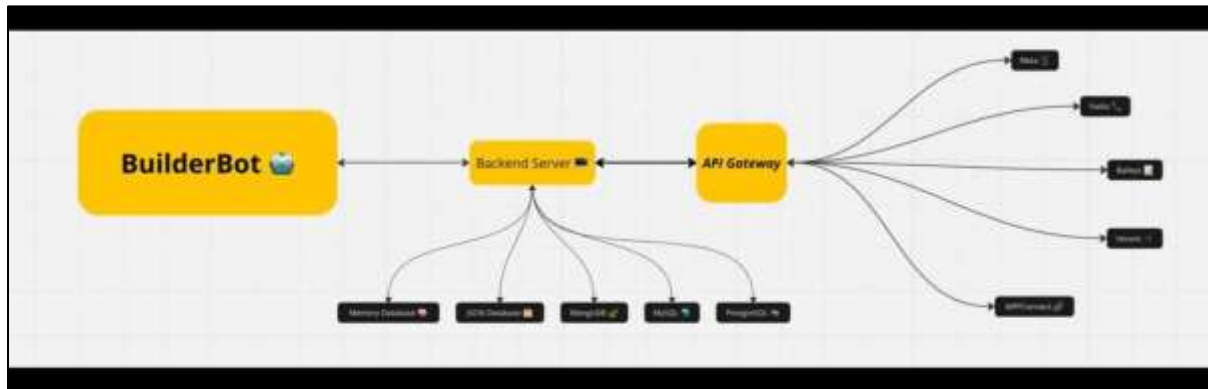


Figure 4. Chatbot architecture. Source: Own elaboration

IV. CONCLUSIONS

In conclusion, a well-designed ChatBot for university use has the ability to be a tool of great value for the institution since it allows improving the student experience by assisting the community at the precise moment they require information since it is shown at the right time and quickly. It is also a tool that offloads the administrative work of some of the processes that students request, making time more efficient. The main challenge is to identify the main doubts of the community, since as they are the most frequently asked questions, if the answers are available among the options, the doubts are cleared up faster and the perception of the level of attention increases. The tool that addresses these doubts through a series of available options is called a static chatbot.

In the event that doubts are not cleared within this bank of options, it is useful to be able to identify the main issue to be solved and from there start to a very particular resolution where Natural Language Processing (NLP) is used to try to identify and learn from the problems raised by the user. that is, to enrich the ChatBot tool.

So far, the result of the application of this conversational agent, which has been for 6 months, has been successful, primary assistance times and resolution of key doubts have been reduced, positively impacting the processes of admissions, registrations, calls for participation, scholarships and others. The impression among the students has also been positive.

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