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Bachelor's Degree in Industrial Technologies and Economic Analysis (IT&EA)

Construction of ETSEIB's website Chatbot with IBM Watson Assistant

REPORT

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Resum

Aquest projecte tracta sobre la creació d'un assistent virtual (xatbot) per la web de l'"Escola Tècnica Superior d'"Enginyeria Industrial de Barcelona (ETSEIB) amb el programa Watson Assistant. Els principals objectius d'aquest treball són disminuir la càrrega de treball de les persones encarregades de respondre les preguntes dels usuaris i millorar l'experiència de la pàgina web.

En aquest treball consta un apartat teòric, on s'explica la definició i l'estat de l'art dels chatbots, així com diferents suports per crear-los. A continuació, s'explica més a fons el funcionament de IBM Watson Assistant, que és l'eina utilitzada per crear el xatbot.

Després de presentar l'eina, s'explica la metodologia emprada en la ideació i la construcció d'aquest. Durant el capítol de la metodologia es fa un paral·lelisme entre com es desenvoluparia el producte per un equip d'IBM i com ho he desenvolupat jo com a particular.

Finalment s'exposa el xatbot a experimentació i se n'extreuen conclusions. Es pot concloure que és una bona manera de donar resposta a preguntes freqüents que entrin dins de l'abast, disminuiria el treball mecànic de resolució de dubtes que hi ha actualment de forma manual i ajuda en la navegació de la pàgina web.

Resumen

Este proyecto trata sobre la creación de un asistente virtual (chatbot) para la web de la Escola Tècnica Superior d'Enginyeria Industrial de Barcelona (ETSEIB) con el programa Watson Assistant. Los objetivos principales de este trabajo son disminuir la carga de trabajo de las personas encargadas de responder las preguntas de los usuarios y mejorar la experiencia de la página web.

En este trabajo consta un apartado teórico, donde se explica la definición y el estado del arte de los chatbots, así como diferentes soportes para la creación de estos. A continuación, se explica más a fondo el funcionamiento de IBM Watson Assistant, que es la herramienta utilizada para crear el chatbot.

Después de presentar la herramienta, se explica la metodología emprada en la ideación y construcción de este. Durante el capítulo de la metodología se hace un paralelismo entre cómo se desarrollaría el producto por un equipo de IBM y como lo he desarrollado yo como particular.

Finalmente se expone el chatbot a experimentación y se extraen conclusiones. Se puede concluir que es una buena manera de dar respuesta a preguntas frecuentes que entren dentro del alcance, disminuiría el trabajo mecánico de resolución de dudas que existe actualmente de forma manual y ayuda en la navegación de la página web.

Abstract

This project deals with the creation of a virtual assistant (chatbot) for Escola Tècnica Superior d'Enginyeria Industrial de Barcelona (ETSEIB) website with the Watson Assistant program. The main objectives of this work are to reduce the workload of the people in charge of answering user questions and to improve the experience of the website.

In this work there is a theoretical section, where the definition and the state of the art of chatbots are explained, as well as different supports for their creation. Next, the operation of IBM Watson Assistant, which is the tool used to create the chatbot, is explained in more depth.

After presenting the tool, the methodology used in its ideation and construction is explained. During the methodology chapter, a parallelism is made between how would the product be developed by an IBM team and how I have developed it as an individual.

Finally, the chatbot is exposed to experimentation and conclusions are drawn. It can be concluded that it is a good way to answer frequently asked questions that fall within the scope of the chatbot, it would reduce the mechanical and repetitive work of resolving questions manually and it would help to navigate the web page.

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1. Introduction

In today's digital era, the integration of artificial intelligence (AI) technologies has revolutionized various aspects of our lives, including how we interact with information and services. These intelligent conversational agents have become increasingly popular in providing instant and personalized support to users at any time.

This thesis focuses on the development and implementation of a virtual assistant, specifically a chatbot, for the university webpage. The objective is to enhance the user experience by offering an efficient and interactive platform for information retrieval and support.

The scope of this project extends beyond the mere creation of a chatbot. It involves designing a comprehensive system that relates the chatbot to the university needs, ensuring user engagement. The primary goal is to optimize the user experience by providing quick and accurate answers to frequently asked questions, reducing the dependency on traditional support channels, and freeing up human resources for more complex tasks.

Through this research, I aim to contribute to the growing body of knowledge in the field of virtual assistants and provide insights into the implementation of AI technologies and specially the importance of every functional detail behind any technological project.

1.1. Motivation

The advent of artificial intelligence (AI) systems has brought about a transformative shift, where computers are now capable of learning and adapting to human language and behavior. With the ongoing advancements in AI, we are rapidly approaching a stage where individuals can communicate naturally with machines, breaking down barriers and enabling seamless interactions.

Was during my internship at IBM, that I had the opportunity to explore the functionalities and wide-ranging applications of virtual assistants and AI. Witnessing the potential and impact of these technologies firsthand, I was inspired to undertake my own project in this field.

The motivation behind this thesis stems from the realization that virtual assistants have the power to revolutionize the way users interact with information and services. By creating an intelligent chatbot, we can enhance the user experience by providing efficient and personalized support. The chatbot will serve as a bridge between users and the vast amount of information available on the university webpage, simplifying access to resources, addressing frequently asked questions, and ultimately enriching the user experience.

I observed that there was an opportunity of improvement of the customer service of the university, and at the same time, by minimizing their workload there would be an energetic saving.

Not only the internship was the source of my motivation, but also the growing importance worldwide that has gain the word “Chatbot” in the last 6 months with the appearance of ChatGPT from the company OpenAI (the visible peak at the end of 2020).

Figure 1.1.1. Search freqüency of the word "chatbot" from 10/06/22 to 10/06/23

In conclusion, the project is driven by the exciting opportunity presented by the convergence of AI and virtual assistants, to address some important aspects like energetic efficiency, improvements in customer service from the university and human-machine communication.

1.2. Objectives

The project's primary aim is to develop a virtual assistant utilizing IBM Watson Assistant to enhance the user experience on the university webpage. The virtual assistant will serve as an efficient and personalized information resource, promptly addressing user inquiries and guiding them through the available webpage content.

Additionally, a key objective is to alleviate the workload and call volume experienced by the staff in the university's call centers, particularly during peak periods. The virtual assistant will automate repetitive tasks like offering general information, handling frequently asked questions, and directing users to relevant resources. This automation will enhance overall operational efficiency.

Furthermore, the project intends to leverage IBM Watson Assistant's capabilities to gather valuable insights and analytics. By analyzing user interactions, the virtual assistant can provide valuable data on user behavior, preferences, and frequently asked questions. These insights will enable data-driven decision-making, leading to improvements in webpage content, structure, and user experience.

The project will be designed with scalability in mind, ensuring future expansion and integration with other university systems and platforms. The objective is to establish a flexible virtual assistant framework that can readily adapt to evolving user needs and integrate with emerging technologies.

Additionally, a noteworthy objective is to design a solution using freely available online tools to demonstrate that anyone can create a chatbot from home without the need for costly training courses or programs.

Collaboration with university staff and students will be an integral part of the project. Regular feedback sessions and user testing will be conducted to gather input and make iterative improvements to the virtual assistant. The aim is to create a solution that effectively addresses the needs and expectations of the university community.

1.3. Scope of the project

The scope of the project is to develop a proof of concept for a virtual assistant using IBM Watson Assistant specifically tailored for the university webpage. A proof of concept is a demonstration in small scale of the total functionalities that to which the solutions could be scale, to analyze whether the product would be useful.

Due to time constraints, limited programming knowledge, and the unavailability of the real ETSEIB webpage, the project's reach will be reduced. However, despite these limitations, the objective is to demonstrate the feasibility and potential of integrating a virtual assistant on the university webpage.

The project will be focused on implementing the virtual assistant with a limited set of topics, comprising a total of 8 areas of knowledge (with multiple questions). These topics have been carefully selected to provide a representative sample of the information and services typically required by users visiting the university webpage. I have selected a specific profile to center the assistance around its specific needs, in order to have a really limited group of people when testing.

While the project's scope may be limited, it serves as a starting point for future expansion and integration of additional topics and functionalities.

1.4. Obstacles and risks

Some obstacles and risks involved in this project are:

- Technical challenges: Developing and integrating a virtual assistant with IBM Watson Assistant can be complex, requiring knowledge of programming languages and understanding of the Watson Assistant platform.

- Time constraint: To develop an entirely functional chatbot covering all the aspects available in the webpage, I would need a larger period of time. Limited time availability for the project will mark its capabilities.

- Limited scope and coverage: Due to the scope limitations mentioned earlier, the virtual assistant may not cover all desired areas of knowledge or provide comprehensive support for user inquiries. This can result in a less satisfactory user experience and potential gaps in functionality.

2. Chatbots

This chapter will be about the historical evolution and the contextualization of the main tools that have been developed during the project, as well as the different types of resources and some advantages and disadvantages of these technologies.

2.1. Related terminology

Before entering completely into discussing the concept of Chatbots, it is convenient to first clarify a series of terms that will be present along this project, in order to help with the comprehension.

The first, and more broad term is **Artificial Intelligence** (AI). Artificial intelligence is a field of computer science that focuses on the creation of systems and programs capable of performing tasks that typically require human intelligence. AI aims to develop algorithms and models that enable machines to process information, learn from it, make decisions, solve problems, and perform tasks autonomously.

Some branches of Artificial intelligence that are of huge value in order to understand how virtual assistants and chatbots work are the following terms: machine learning, deep learning and natural language processing.

Machine learning is a discipline inside AI that is centered in the development of algorithms and models that allow machines to learn in an autonomous way from given data. Is a wide approach that includes many techniques to train models and do predictions based on identified patterns of the data.

Deep learning is a branch of machine learning based on artificial neural networks composed by multiple layers. These neural networks are design to learn data representations with different levels of abstraction, and each layer processes the information progressively, extracting characteristics and patterns more complex each time. It is widely use with images, texts, sounds and other types of data. As more information is provided to them, they adjust their connections to improve their ability to make predictions or decisions.

Another term to bear into consideration, when talking about chatbots is **natural language processing,** which is the term connecting computer interactions with human language. It uses machine learning and deep learning to enable computers to comprehend, process and generate natural language. The ultimate goal of NLP is that a machine can recognize what a person is saying with their natural language, that being written, oral or signs.

Another term related with the design of chatbots are **user interface**, which refers to the means and methods with which a user interacts with a system of computer program. User interface can include visual elements, like screens and buttons, as well as interactions by text, voice or gestures.

2.2. Concept and characteristics

Chatbot, chatterbot or conversational agent are some of the terms to refer to the type of bots that are specialized in maintaining conversations and offering preconceived answers. It comes from the term bot, which in turn, is an abbreviation for robot. The attributes between these last two are notably similar, which blurs the border between them, but the main difference is that the robot needs a physical support in order to be developed, whereas a bot can be entirely virtual.

A chatbot is an AI program designed to interact with users through a text or voice-based conversation. It uses natural language processing techniques and machine learning algorithms to understand and respond to user requests. Its characteristics can vary depending on its design and objective, but the main ones are:

- **Conversational interaction.** Chatbots are design to maintain natural conversations with its users, as if they were interacting with a human. They can answer questions, give information, complete tasks and obey orders following the requests of its users.

- **Natural language processing.** Chatbot use these technics to understand and analyze human language. It enables the program to interpret the intentions of the users, extract relevant information and generate coherent and comprehensible answers.

- **Autonomy and adaptability.** Refers to the bot's ability to adapt on its own, without human intervention, to a changing environment relying on their past experience and their learning capacity to adjust answers to offer a more precise and accurate experience. It uses automatic learning algorithms to improve their skills while interacting with users.

- **Personality.** The program developer has the possibility to define the behavior and tone of the conversation, to adapt to the individual needs and preferences of each user. It can remember information and previous context to offer more relevant and personalized answers.

- **Platform and service integration.** It is not necessary to download a new app for the user to interact with the chatbot. It can be integrated with different platforms and

services, such as websites, instant messaging applications, and customer management systems. This allows them to interact with users through multiple channels and access relevant information from different sources.

- **Ease of interaction.** The user can interact with the chatbot through text, links, images or call-to-action buttons. The result is faster and easier communication.

- **Availability 24/7.** Chatbots are always available, allowing users to interact with them at any time and from anywhere. This provides immediate and constant assistance without the need for human intervention.

2.3. Origin and evolution

The chatbot concept appears for the first time in the 1960s. However, it will not be until half a century later that they will be truly implemented in real life thanks to advances in natural language processing, artificial intelligence and the proliferation of messaging applications. Next, we will know its origin and evolution.

2.3.1. Background of chatbots. Turing-test

Its origins date back to 1950 when Alan Turing (1950) published the article "Computing Machinery and Intelligence".

Turing begins this text by contemplating the possibility of a machine being capable of thinking and proposes an "imitation game" (later known as the Turing Test) to test it. The game involves three participants: a man (A), a woman (B), and an investigator (C). Subjects A and B are in a separate room from subject C, and both have to convince the investigator that they are a woman by communicating with him through written language. The figure represents the first phase of the game.

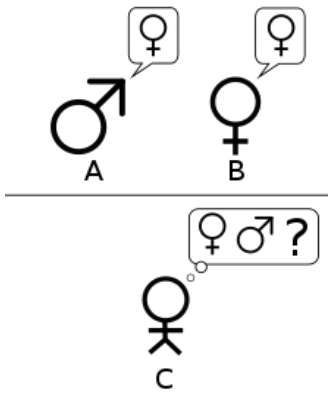


Figure 2.3.1.1. Turing's imitation Game

To evaluate the intelligence of a machine, Turing proposes replacing one of the participants, A or B, with a machine that assumes their role and tries to convince the investigator. In this case, the participants would be a machine (A), a human of any gender (B), and an investigator (C). The goal of the Turing Test is to demonstrate the machine's ability to imitate human behavior (Saygin, Cicekly, and Akman, 2000). The incorporation of the machine and the new composition of the participants are illustrated in Figure 3.2.

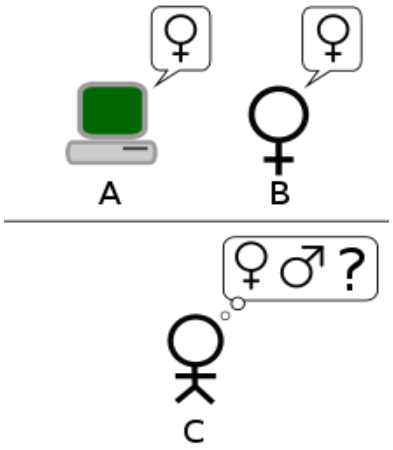


Figure 2.3.1.2. Turing's imitation game with a machine

If the investigator is no capable of distinguishing between the human and the computer, the machine will have passed the test, and it would be considered intelligent.

2.3.2. Beginnings of chatbots

The Turing Test was a source of inspiration for many computer scientists, including Joseph Weizenbaum, who created one of the earliest known bots in 1964, called Eliza. The objective of Eliza was to simulate the conversation between a psychologist and a human. Although its conversational ability was not very advanced, it was sufficient to confuse people.

The operation of Eliza consisted of identifying the keywords in the message, determining the context, and selecting the most appropriate rule to respond to the user. Essentially, it relied on rephrasing the input sentence when it matched one of its predefined rules.

user: *You are entitled to your opinion.*
ELIZA: *What makes you think I am entitled to my opinion?*

Figure 2.3.2.1. Conversation of Eliza

However, some scientist state that this computer program had a series of limitations, and often, due to not understanding the message, it would respond with incoherent phrases.

Some authors consider Eliza to be the first program capable of passing the Turing Test, although this claim is subjected to different interpretations because it could not be officially verified. It was in 1990 when a formal instance was first created to evaluate different chatbots using the Turing method, known as the Loebner Prize. Although no chatbot has strictly passed this test to date, each year a "winner" is chosen, which is the one that appears the most human.

2.3.3. Chatbot chronology

Like Eliza, many other chatbots entered the scene in subsequent years until today.

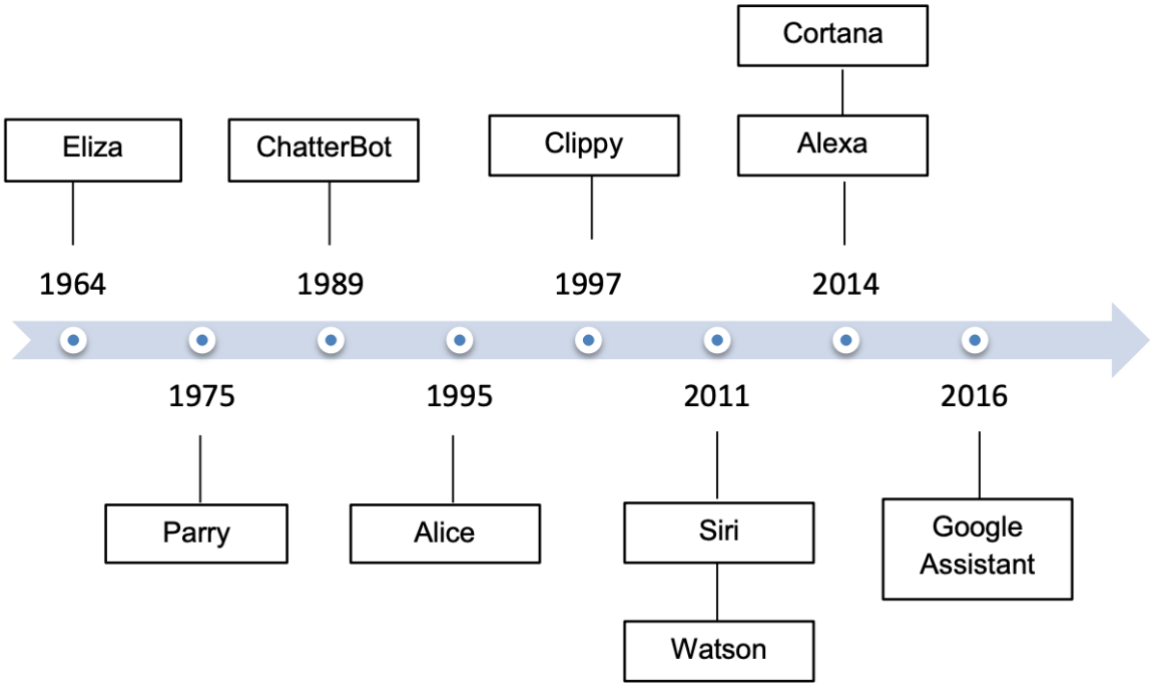


Figure 2.3.3.1. Chatbot cronology

The history of chatbots can be traced back to 1975 with the introduction of Parry, a chatbot that simulated a schizophrenic patient. Over the years, advancements were made to make chatbots more interactive and human-like. In 1989, Chatterbot emerged as a virtual player in games, incorporating humor and realistic typing simulations. In 1995, ALICE was developed, capable of responding to user questions and even lying, although it had limitations in knowledge. Microsoft's Clippy, introduced later, proved to be frustrating for users with continuous wrong suggestions.

The year 2011 marked a significant breakthrough with the introduction of Siri, a conversational bot functioning as a personal assistant, utilizing voice recognition and natural language processing. IBM's Watson, also introduced in 2011, excelled in answering questions by employing advanced natural language processing and machine learning techniques. Cortana, Alexa, and Google Assistant emerged between 2014 and 2016, assuming the role of personal assistants and utilizing cloud services for data storage and connectivity with various devices.

A notable advancement in chatbot technology came with the introduction of ChatGPT, an AI language model developed by OpenAI. ChatGPT leverages large language models to generate coherent and contextually relevant text responses in a conversational manner. Despite its capabilities, it has limitations such as incomplete knowledge, bias, and a need for continual improvement.

The popularity of chatbots has grown exponentially due to their availability to clients at any time and place. Additionally, platforms like DialogFlow, Watson, and Amazon Lex are simplifying the creation of chatbots by providing services that eliminate the need for coding.

2.4. Chatbot development frameworks

A chatbot framework is a solution specifically created for developing bots and defining their behavior. It decreases the amount of manual work that is normally involved in building a chatbot.

A bot developing framework usually includes a bot builder SDK, bot connectors, bot directory, and developer portal. Once you develop your chatbot, there's a console to help you test it. Simply put, bot frameworks offer a set of tools that help developers create chatbots better and faster.

It is not the same a chatbot framework that a chatbot platform. Chatbot platforms are usually ready-to-use solutions with visual builders. When it comes to chatbot frameworks, they give you more flexibility in developing your bots. However, frameworks may require coding for developing more advanced solutions.

Some of the most famous chatbot frameworks are:

- **DialogFlow**: Chatbot development framework created in 2010 and maintained by Google. It is capable of understanding natural language and provides us with tools for creating dialogues and recreating conversations. It stands out for the large number of conversation interfaces in which it can be deployed (Google home, google assistant, wearables, phones, cars). It has support for more than 14 languages and can resolve abbreviations and work with misspellings.

- **IBM Watson:** Created by IBM, it is able to understand and answer user questions

using natural language understanding. Watson is currently comprised of a cluster of at least 750 IBM Power 750 servers, with about 16TB of RAM, thus making it one of the most powerful supercomputers in the world. Also offers great privacy and security measures for your chatbots, including visual recognition security. It isolates the gathered information in a private cloud to secure the user data and insights. It also provides a variety of bot-building toolkits and advanced cognitive capabilities. You can use predictive analytics to make better-informed business decisions in the future.

- **Amazon Lex:** Created and managed by Amazon, it allows you to establish communications with all your Eco products and with your virtual assistant Alexa. It is one of the best tools in terms of speech to text conversion. With this tool you can create bots with a sophisticated natural language. On the other hand, this framework doesn't process languages other than English.

- **Rasa:** Open Source Machine Learning framework. It has tools to understand the user through the Rasa NLU (Natural Language Understanding) component, to generate the dialog with Rasa NIG (Natural Language Generation) and an engine (Rasa Core) capable of defining what will be the next action to take based on the message transmitted by the user. You can store data in customer databases to grow your understanding of your clients. The disadvantage of using Rasa is that it is not suitable for beginners as it requires you to have an understanding of NLP, Deep learning, and known Python language to build contextual chatbots.

2.5. Advantages and disadvantages of using chatbots in a professional environment

The appearance of virtual assistants has allowed the improvement and automation of processes and services within the professional environment, but since they do not have all the skills that a human possesses, their use also has certain drawbacks.

2.5.1. Advantages

Availability: Unlike human agents who have limitations in terms of working hours, a Chatbot can be available 24/7, providing instant assistance to customers at any time. This ensures that customers can access support or information whenever they need it, leading to enhanced customer satisfaction and loyalty.

Knowledge of Customer insights: through humans interactions they can gather information about customer preferences, behaviors, and needs. By leveraging this data, businesses can gain valuable insights into their customers, allowing them to tailor their

products, services, and marketing strategies accordingly. This knowledge helps businesses to better understand their target audience and deliver personalized experiences.

Cost reduction: Implementing a Chatbot can significantly reduce operational costs for businesses. Chatbots can handle a large volume of customer inquiries simultaneously, reducing the need for a large customer support team. This cost-saving advantage is particularly beneficial for businesses that receive a high volume of repetitive and frequently asked questions. By automating these interactions, companies can allocate resources more efficiently and reduce the overall customer service expenses.

Efficiency: Chatbots excel in providing quick and efficient customer support. They can instantly respond to customer queries, provide relevant information, and guide users through various processes or transactions. By automating routine tasks and resolving common issues, Chatbots free up human agents to focus on more complex or specialized tasks. This improves overall operational efficiency and allows businesses to deliver faster and more consistent customer service.

Increase in sales: By engaging customers in interactive conversations, Chatbots can offer personalized product recommendations, provide information about promotions or discounts, and assist in the purchasing process. This personalized and proactive approach can help businesses drive sales, upsell or cross-sell products, and enhance the overall customer shopping experience.

2.5.2. Disadvantages

Intelligence: Even if it has artificial intelligence implemented, an assistant is not more intelligent than a human and there are times when it does not understand the message that the user gives it and can cause a jam in the process. This can lead to the fact that if the user loses patience, the purchase process is not completed.

Limited range of topics: Chatbots are designed to handle specific tasks or address predefined topics. They rely on pre-programmed responses and may struggle with complex or out-of-context queries. If a user goes beyond the chatbot's programmed capabilities or asks questions outside its knowledge base, the chatbot may not be able to provide accurate or helpful responses.

Mechanical tone: Chatbots, being automated systems, often lack the human touch and natural conversational tone. They may sound robotic and lack the empathy or emotional intelligence that a human agent can provide. This can sometimes lead to a less engaging and impersonal customer experience.

Cost: building a chatbot requires investment in programming, integration with existing

systems, and training it to understand user queries.

Time: Implementing a chatbot can be a time-consuming process. Designing an effective chatbot requires careful planning, development, testing, and refining. Additionally, training the chatbot to understand user queries and providing accurate responses takes time. Organizations need to allocate resources and dedicate time to ensure the chatbot performs as intended.

Maintenance: they require continuous maintenance and updates to stay relevant and effective. As user needs evolve, new features or capabilities may need to be added to the chatbot. Regular monitoring is necessary to identify and fix any issues or bugs that may arise. This ongoing maintenance requires resources and effort to keep the chatbot functioning optimally.

2.6. Applications

Businesses are being dragged by the digital age and managers are increasingly aware of the benefits that applications, working in the cloud and automation can bring them.

2.6.1. Education environments

One key application is personalized learning support, where chatbots are capable of delivering tailored educational content, resources, and guidance based on individual student needs. By adapting to the pace and style of each learner, chatbots offer customized recommendations and assistance, ensuring that students receive the support they require to succeed. Furthermore, chatbots provide instant assistance and support to students by addressing their queries and providing prompt responses to their questions. Chatbots help students overcome learning obstacles and improve their engagement and satisfaction with the educational material. They can help with tasks such as course enrollment, scheduling, accessing educational materials, and tracking progress. Offering pronunciation feedback, vocabulary and grammar practice, and engaging dialogue to enhance the language learning process.

2.6.2. Health

In health care, chatbots are designed to provide patients with customized health and therapy information, patient-related products and services, and offer diagnosis and suggest treatments based on patient symptoms. These chatbots, cater to various healthcare needs, ranging from cancer awareness to emotional well-being and medication reminders.

Particularly during the COVID-19 pandemic, chatbots like HealthBuddy have been deployed to offer information and engage with communities.

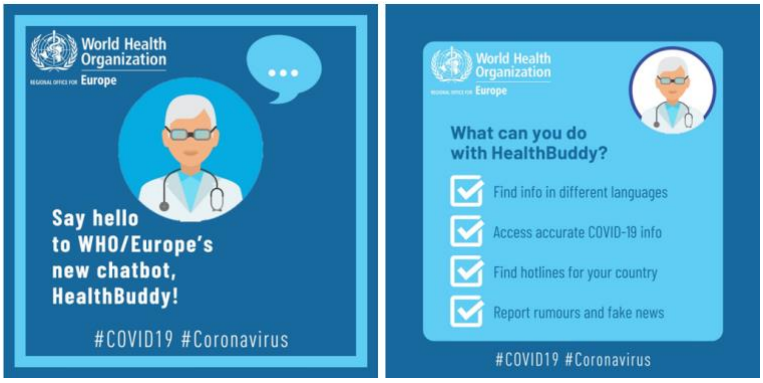


Figure 2.6.2.1. HealtBuddy the covid assist chatbot

The advantages of using healthcare chatbots include supporting medical decision-making, promoting physical exercise, assisting cognitive-behavioral therapy, and managing somatic disorders. Patients often perceive chatbots as reliable partners, sharing more information and symptoms compared to human physicians. However, adherence to chatbot recommendations may be weaker due to concerns about consistency and transparency.

Chatbots offer advantages over human physicians, as they are unbiased, available 24/7, cost-effective, and capable of multilingual interactions. They can cater to patients' specific needs without being affected by factors like gender, age, or race. Additionally, chatbots do not experience fatigue or illness, making them a valuable resource for individuals with health concerns beyond regular working hours.

2.6.3. Industrial use cases

In the banking sector, chatbots talk to customers and, among other services, provide information about their account balances, facilitate their bill payments, suggest ways to save resources and help activate cards. At the same time, they assist the Bank in collecting feedback from customers. The conjunction of technology and finance has resulted in the emergence of FinTech or Financial Technology, automated investment solutions that connect individuals with digital tools, which feature advanced customer experience to guide them through a self-assessment process and shape their investment behavior based on objectives.

In the food industry, chatbots accept and track orders, arrange delivery details, make reservations, ask for customer feedback, inform customers on offers and discounts and answer customer questions based on the company's FAQs. One example is the chatbot developed by Burguer King, integrated with Whatsapp.

2.6.4. Customer service

Customer service is essential in the satisfaction of users and consumers. Thanks to the development of artificial intelligence, an increasing number of marketing professionals are opting for bots to improve their connection with customers and offer something digitally distinctive. According to a survey conducted by LivePerson (2017) among consumers from North America, Europe, Asia, and Oceania, 52% of global consumers would not be willing to wait more than two minutes to speak with a customer service agent. As fast service is a priority for consumers, more and more companies are choosing to include bots in their customer service strategies.

An important aspect to consider is that the chatbot should have a human-like appearance. About half of the respondents in Europe and Asia, according to LivePerson, consider it important for the chatbot to have a name and a friendly personality. Examples of virtual assistants in customer service include Nikko from Movistar and Amanda from Amadeus Selling Platform. The former achieved a 30% reduction in customer service costs, while the latter achieved a 70% customer retention rate compared to traditional services.

One the most appealing aspects of adding a chatbot into a customer service is the instant assistance 24/7. They can handle a large volume of customer inquiries simultaneously by providing automated responses based on predefined rules and algorithms. This helps reduce the waiting time for customers and increases the efficiency of customer service operations. Also, it ensures that all answers to the same questions are being the same, as the company doesn’t have different human-agents responding in a biased way.

3. IBM Watson

The chatbot framework that I have used to create my virtual assistant is IBM Watson Assistant.

As mentioned earlier, IBM Watson is an artificial intelligence (AI) platform developed by IBM. It is designed to analyze and understand vast amounts of data, learn from it, and provide intelligent insights and solutions to various industries and domains. The data given to understand and analyze can be in different formats, such as text, images, and videos.

IBM Watson was named after IBM's first CEO, Thomas J. Watson. The technology behind Watson was originally developed in an IBM research project known as DeepQA. The goal of the project was to develop a natural language-responsive system that could interpret questions asked in a human language and then analyze vast amounts of data and return answers that it would take human researchers days, weeks, or even months to derive.

It has learnt by loading a "**corpus**" of knowledge into Watson. This literature was cleaned and organized in order to discard anything that is out of date, poorly regarded or immaterial to the problem domain. This process is called **curating the content.**

Next, the data was preprocessed by Watson building metadata to work with that data more efficient, known as **ingestion**. Then an expert has to train the model with machine learning, by associating specific questions with answers. This doesn't give Watson explicit answers to all the questions it may receive, but rather it teaches the linguistic patterns of meaning in the domain. Once Watson has been trained with Q&A pairs, it keeps learning with periodic interactions (which are supervised by experts), likewise new information is being updated.

After identifying parts of speech in a question or inquiry it generates **hypothesis**. Watson then looks for evidence to support or refute the hypothesis. It scores each passage based on statistical modelling for each piece of evidence known as **weighted evidence scores**. Estimates its confidence based on how high the response is rated.

IBM Watson is available as a cloud-based platform, known as IBM Watson Cloud. It allows developers to access and utilize Watson's capabilities via APIs, making it scalable and easily accessible. These foreign resources called APIs provide access to various Watson services such as natural language understanding, language translation, image recognition, and more.

3.1. Natural language processing

One of the most important parts of a virtual assistant is Natural Language Processing (NLP),

thanks to this tool, the program is capable of understanding the way in which we humans express ourselves, which is in an unstructured way (from the point of view of a computer). In order for a computer to understand the meaning of a sentence, we need a structured representation of that same information. The computer needs to identify the elements of a sentences and its sub element. Therefore, the job of natural language processing is to translate between the two structures. If a machine transforms “unstructured” to “structured” data is called Natural Language Understanding, and when it goes the other way it is called Natural Language Generation. The most appealing functionalities are:

- **Natural language comprehension:** necessary to analyze what the user is saying and understand the message.
- **Tokenization:** taking a string and breaking it down into smaller structures that the program can label and process. Then it uses stemming or lemmatization to learn its meaning through a dictionary definition and from there it can derive its root or its lem.
- **Part of speech tagging:** for a given token its looking where that token is used within the context of a sentence, because depending on the part of the speech in which is used that token it has a given meaning.
- **Named entity recognition:** it analyses if there is an entity associated to a given token.
- **Natural language generation:** capacity to choose the most appropriate answer to the issue and creating a response with a human tone.
- **Emotions detection and sentiment analysis:** deriving the sentiment that it is expressed in a given sentence. For example, differentiation from positive to negative statements or serious to sarcastic statements.

3.2. Watson Assistant

Watson Assistant is a specific service within the IBM Watson platform. It is an AI-powered chatbot and virtual assistant solution that enables businesses to build and deploy conversational interfaces. Watson Assistant uses natural language understanding to comprehend user input and provide relevant responses or actions.

There are four main algorithms working within virtual assistants.

- **Input Analysis:** When a user interacts with Watson Assistant, their input is analyzed by the NLU model. The text is parsed and broken down into its individual

components, such as sentences, phrases, and words.

- **Tokenization:** The text is tokenized, meaning that each word or phrase is assigned a specific token or label. This helps Watson Assistant understand the structure and meaning of the input.

- **Language Understanding**: Watson Assistant employs various natural language processing techniques to extract the meaning and intent behind the user's input. This involves tasks such as:

    1. **Intent detection**: it can detect the overall idea, not only the meaning behind each word. No matter how it's phrased, the AI helps detect the intent of the phrase.

    2. **Entity detection:** it identifies the entity in which relays the action of the intent.

    3. **Irrelevance detection**: helps the virtual assistant to recognize when the request is off topic.

    4. **Autocorrection:** it doesn't punish for spelling mistakes.

- **Response Generation:** Once the user input is understood, Watson Assistant generates an appropriate response based on the identified intent and contextual information. The response can be predefined, such as providing a specific answer to a frequently asked question, or it can be dynamically generated based on data or external APIs.

- **Dialog Management:** Watson Assistant manages the flow and structure of the conversation by maintaining a dialog context. It determines when to ask for clarification, when to prompt the user for more information, and when to provide a final response.

Watson Assistant offers a range of features and capabilities, such as personalized interactions, context awareness, and integration with back-end systems. It also supports multi-turn conversations, where the chatbot can remember previous interactions and maintain context to provide more accurate and relevant responses.

Customers interact with the assistant through one or more of these channels:

- A web chat embed in a company website and that can transfer complex requests to a customer support representative.

- An existing social-media messaging platform, such as Slack, Facebook Messenger,

or WhatsApp

- A phone call or text message
- A custom application developed, such as a mobile app or a robot with a voice interface

The **assistant** receives a message from a customer and sends it down the appropriate resolution path.

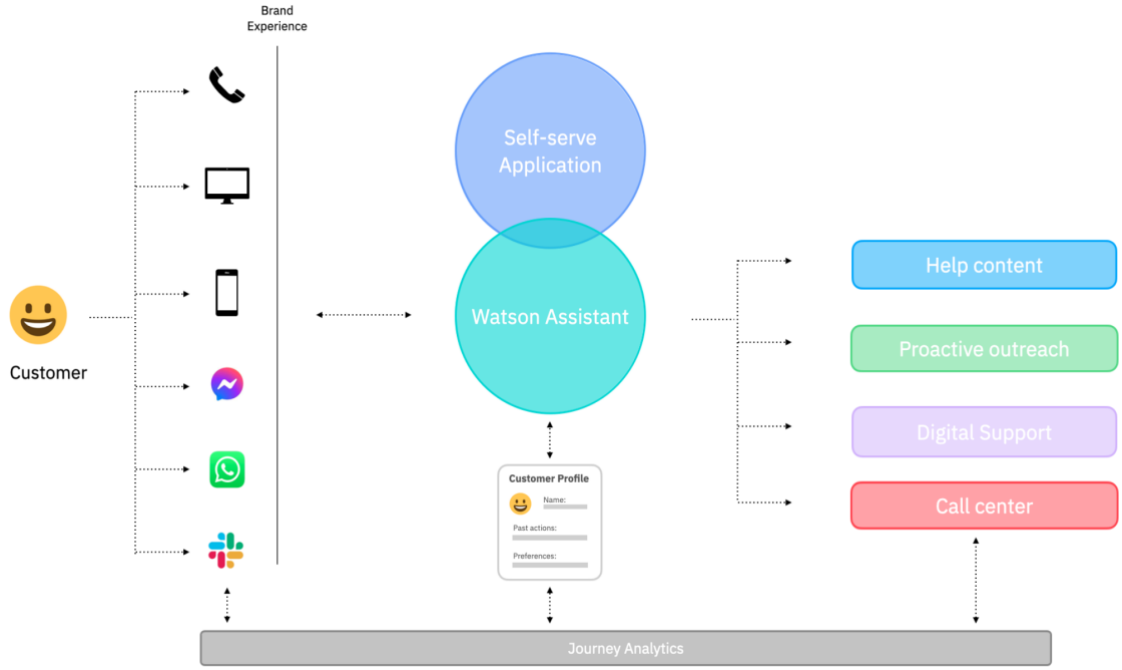


Figure 3.2.1. Watson Assistant channel scheme

4. Methodology

This chapter is about the process that I followed to create the chatbot. This process is guided by the recommended methodology of best practices described by IBM to design, build and produce a chatbot for a client. In this case I act as an employee and ETSEIB would be the company which has hired IBM for the production of a chatbot.

I explain the steps and methodology that is essential to follow to create a virtual assistant, while I show how I carried out each step to create the final product by myself.

The steps to follow are the following:

1. Plannning of tasks and budget.
2. Define the purpose and scope of the project.
3. Decide the target audience and tone.
4. Construct the conversational trees.
5. User experience.
6. Training.
7. Production and tests

Most of these steps in a real company would be carried out by different professionals, each one specialized in a field. The professionals that would be needed in a project like this in a big scale would be: Project manager, Back-end developer, front-end developer, consultant analyst and a consultant developer.

In the case of this project all the tasks have been carried out by a single person.

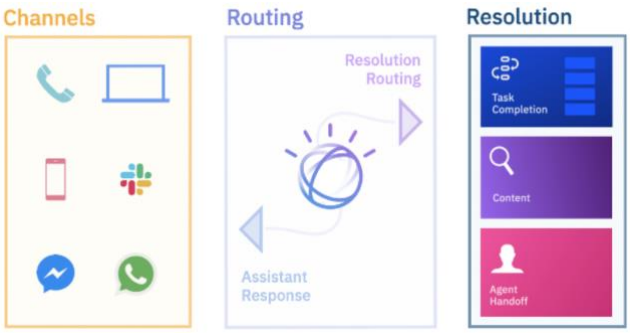


Figure 4.1. Definition of Watson Assistant functioning

4.1. Planning of tasks and budget

The most important thing when starting a project is to plan all the tasks, make a provision for the time that is going to be needed and mark the necessary budget to carry out the project. The latter with the intention of presenting the project to the client so that they accept the budget and so that both the client and the company are aligned with the duration of the project.

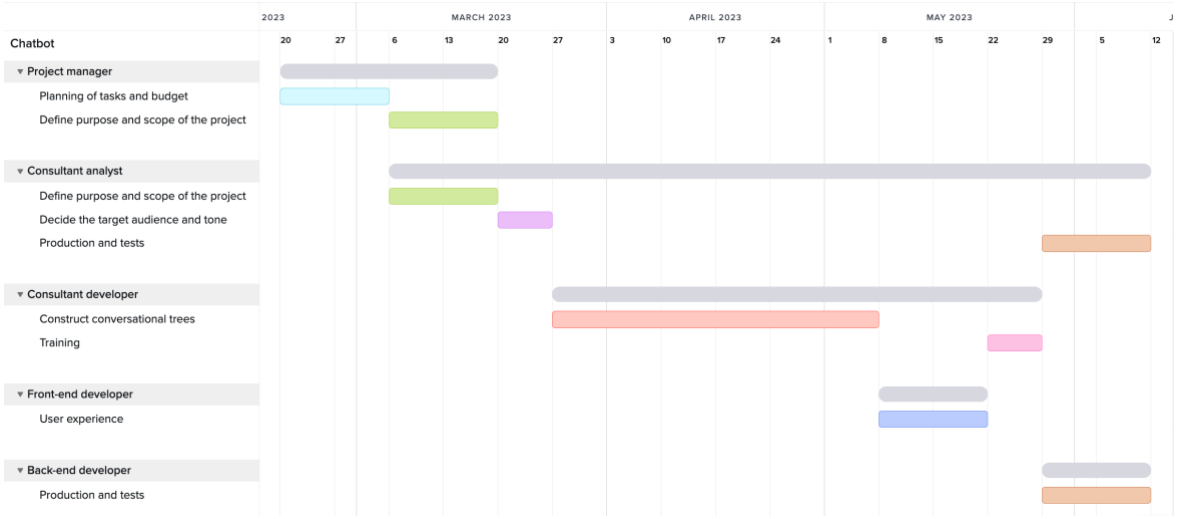
As I mentioned earlier each professional would be carrying out a different task. In the Table below there are the tasks defined, how are distributed around the team and the time that it should take to complete them.

Table 4.1.1. Distribution of professionals with tasks

Task	Professional	Time
Planning of tasks and budget	Project manager	2 weeks
Define purpose and scope of the project	Project manager, consultant analyst	2 weeks each one
Decide the target audience and tone	Consultant analyst	1 week
Construct conversational trees	Consultant developer	6 weeks
User experience	Front-end developer	2 weeks
Training	Consultant developer	1 week
Production and tests	Back-end developer, consultant analyst	2 weeks each one

As part of the planning step the project manager can carry out a Gantt diagram to distribute the tasks through time and personnel. In this task I'm having the role of project manager and I distributed the work in the following way.

Table 4.1.2. Gantt diagram with tasks



The project manager would have to propose a budget of the project, so that the client accepts the offer. In order to calculate the total budget of the project we have to multiplicate the hourly wage of each professional by the time they will spend working in the project.

Table 4.1.3. Distribution of tasks by professional

Hours	Professional	Hourly wage without IVA	Total without IVA	Total with IVA
160	Project manager	73,00€	11.680 €	14.132,80 €
80	Back-end developer	63,00€	5.040 €	6.098,40 €
80	Front-end developer	36,00€	2.880 €	3.484,80 €
200	Consultant analyst	54,00€	10.800 €	13.068,00€
280	Consultant developer	45,00€	12.600 €	15.264,00€
Total			**43.000 €**	**52.030,00€**

To the total price that appears in the table above, the company should add a 10% of the amount as part of a contingency plan. So the final budget would go from 52.030 € to 57.233€. The client must take into account that by implementing the virtual assistant it will eventually save because of the increase in efficiency and the cut in human-agents (salaries).

Finally, if the client accepts the offer, the company would start the project, and continue with the next steps.

4.2. Define the purpose and scope of the project

The ultimate purpose of the chatbot is to reduce costs. That means minimizing the calls that must be answered by human-agents, less staff working…

It has been found that almost all the questions are answered in the web, but people don't spend the time looking for them, they want a personalized answer to a specific doubt. Therefore, the goal is to use the chatbot to give some information that may be found in the web on a more personalized way, so that the students feel that they are receiving a closer treatment.

ETSEIB offers many different courses for which the information differs (two degrees, thirteen masters and other career paths), that is why it is important to set the scope of the project and to specify which questions are going to be answered with the chatbot.

This step of the process for a real company would be carried out by the project manager and the consultant analyst, by carrying out sessions of design thinking with the client. In this case it was me that I defined the purpose and scope of the project.

I have set the scope of the chatbot to answer questions only relative to the degrees that the university offers:

1. Grau en Enginyeria en Technologies Industrials

2. Bachelor's Degree in Industrial Technologies and Economic Analysis

In order to start building the chatbot, I needed to know in depth what information was offering and the problematics that the university was facing nowadays, to discover what features and topics had to be covered with the chatbot, or if it was even going to be helpful at all. As I mentioned earlier, ETSEIB is the client and I am the consultant that was going to build the solution.

The steps that I followed to do the research of the needs of this project were:

Question grouping. Questions and/or real user queries must be analyzed and grouped to detect the different actions.

I analyzed all the documents of FAQs that are publicly posted. I also studied the different topics covered through the website and the different profiles of visitants the website could have. Being an ex-student myself made it easier to have an idea of the frequently asked topics or interests that a student could have when entering the website.

Group workshop. The client exposes its needs to build an idea of the functionalities needed in the solution.

To identify what the client's needs were, I exchanged emails and phone calls with the people in charge of answering the student's queries. And they informed me about the most common questions and the problems. I categorized all the questions and divided them into different clusters.

After gathering all the information about the needs of ETSEIB I had to set the purpose, goals and scope of the project.

4.3. Target audience and tone

The positioning of the chatbot is key success factor. Because it is important to align the purpose of the solution with the viewpoint or personality that our chatbot is going to adopt.

In order to identify the target audience, it is important to know the needs of the different people that can enter to the website. There are two main groups that use ETSEIB's website:

1. Students already enrolled in a course, looking for specific piece of information.

2. Potential future students wanting to know more about the university.

In order to set an even tighter scope of the project I chose to focus the type of questions for a person that is not an ETSEIB's student yet, but rather looking for information in order to make the decision of applying or not. Or choosing between applying to Grau en Enginyeria en Technologies Industrials or Bachelor's Degree in Industrial Technologies and Economic Analysis.

In a second version of the project, it can be added to answer the questions of the students that are already enrolled in a course. This answer could even be a personalized answer if the person that is chatting with the bot has identified and logged in. The questions and answers would also be different, even the tone of the chatbot could change, that is why I will be focusing my project on the potential students visiting the webpage.

Now that we have set the profile of people that will be using the chat, we can set the tone.

A chatbot can have different viewpoints: helper, guide, motivator, conversationalist, regulator, salesperson… what we are looking for in our project is for a friendly companion. In order to differentiate the seriousness and coldness a university can reflect, I would like the chatbot to have a warm and close tone, almost as an older friend that is giving you advise about the university.

A chatbot can also be reactive (wait for the user to make questions) or proactive (the solution reaches out the user). I have designed the assistant to be proactive, because knowing that our public are potential future students, the chatbot should be rather selling the university and showing the user what has to offer. Some characteristics of a proactive chatbot are: initiating action off the user, give options so user can decide what its coming next, resolving the questions to avoid calling the call center, show users how the solution can help them, drive user engagement, increasing sympathy and “forgiveness” in users.

To sum up, the target audience of the chatbot will be potential future students visiting the website to decide whether to apply to a degree or not. The viewpoint will be of an “omnipresent” peer student that knows everything about the university, and the tone will be close and proactive in order to engage the student to keep asking questions and getting to know the university.

4.4. Construction of conversational trees

This is the main part of the project and consists of building all the dialogs and logics in order to the assistant to respond one thing or another. This task would be carried out by a consultant developer.

In order to star creating the conversational tress the assistant has to be created. I choose a name and a language in which the training is going to take part. I chose the name ETSEIBot and the language Spanish.

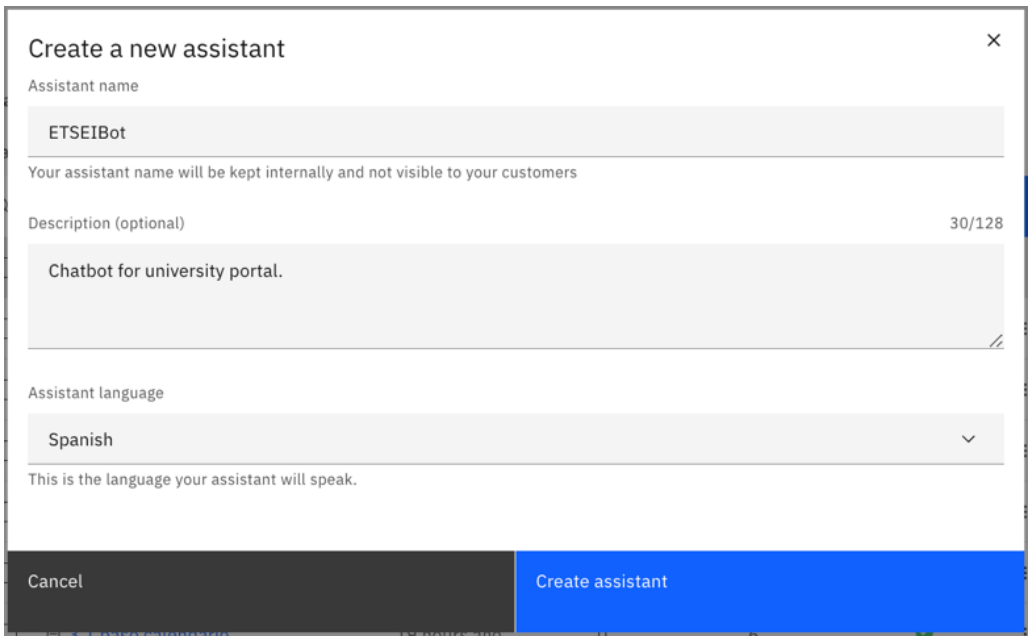


Figure 4.4.1. Creation of chatbot wit Watson Assistant

4.4.1. Actions

After creating the chatbot, we need to start building the conversational trees that will cover the topics of our assistant. The different questions or tasks that the customer wants to resolve are called actions. Some best practices that the actions must follow are:

- Clear and descriptive nomenclature
- Clearly differentiated between one and other.
- The variations of actions must be unique.
- Limit the number of actions: To control domains.

It is important to avoid too generic actions (large volume of similar entities, synonyms, complex flows…) and too specific actions (difficult to distinguish the correct one for Watson, low confidence percentages, overlapping examples…).

Figure 4.4.1.1. Behaviour of conversational trees

The actions chosen to be within the scope of the project and the different questions that each answers provides are:

1. **What is ETSEIB:** Video introduction to ETSEIB and map with address of the school.
2. **Information about the available degrees:** Information about *Grau en Enginyeria en Tecnologies Industrials* (duration, credits, teaching type, mark to enter, number of people), information about Bachelor's degree in Industrial Technologies and Economic Analysis (duration, credits, teaching type, mark to enter, number of people), comparison between general information of both degrees.
3. **Information about the academic calendar**: link to academic calendar, first period calendar, second period calendar, Bachelor's degree in Industrial Technologies and Economic small specifications.
4. **How can I access the degrees:** students with PAU, students of foreign educational systems, students with the access test for more than 25 years, students with the access test for more than 45 years.
5. **Can I validate subjects**: different ways of nonvalidating subjects.

6. **What subject count for entering to the degree:** comparative table between both degrees.

7. **What scholarships exist?**

8. **How is the schedule for the first year?**

As it is mentioned earlier, as it is a proactive chatbot, because we are interested in informing and selling ETSEIB to the person that is visiting the webpage, there are some answers that give more information than the information asked.

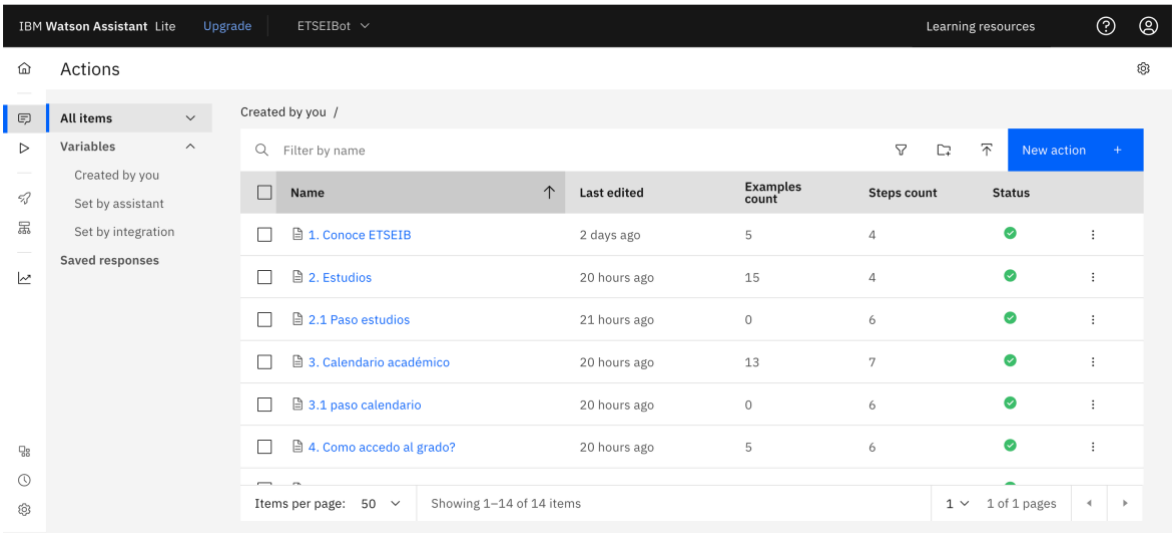


Figure 4.4.1.2. Actions repository of Watson Assistant

In addition to the 7 possible questions there are 4 more actions that are: greetings, goodbyes, offenses and change of topic. These actions are the most important ones when trying to humanize our machine and ensure that the bot has an answer to every question that the user performs.

4.4.2. Steps

Once the actions have been defined it is time to design each conversational tree by building the steps. Some points to have into consideration is that the dialog has to be flexible; the student can ask for different things, jump from question to question, chose different inputs, set different conditions… It is a good practice to apply the “Flow & State” method, helping to lead the conversation, remembering what has been asked or where do we want our conversation to go.

As the objective is to build a proactive chatbot, it has to be concise proposing buttons or options to choose from and it has to be confident in front of questions that are outside of the

scope, instead of giving and incorrect answer.

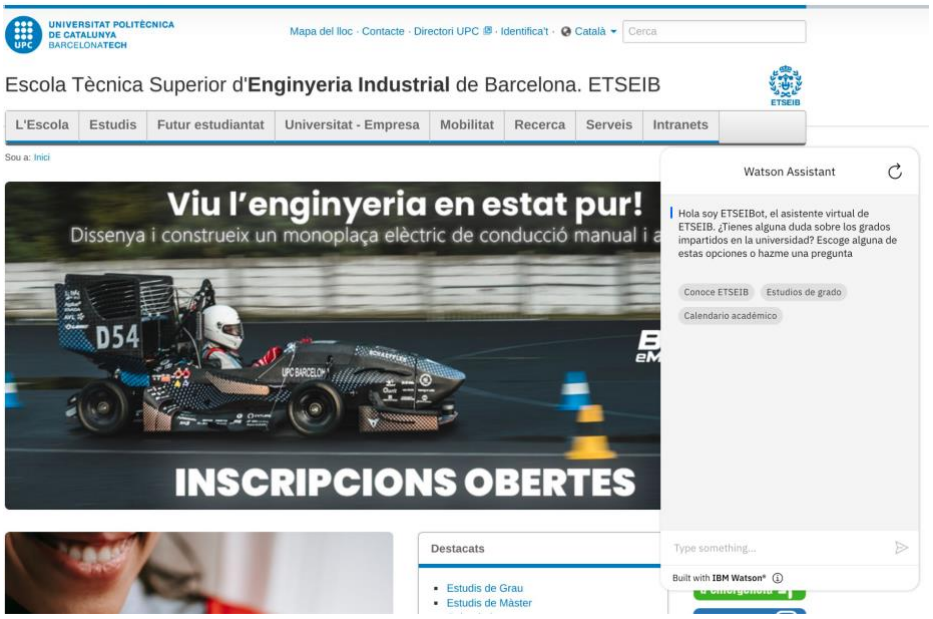


Figure 4.4.2.1. Preview of the chatbot in ETSEIB's website

It is very important to plan de conversations and the different branches an action can have. I organized the conversational trees with a tool called Miro, in order to organize and verify that each action was concise and useful. After the planning I started building each action with Watson.

The design of the conversational tree is held by adding conditions and variables in order to enter to a specific step or skip it, depending on the answer of the user.

Designing the conversational trees is one of the largest steps to complete, because it is hard to define all the dialogs and logics behind the flow of the conversation. Specially the actions that have different options, and the option have to be available when the user finishes reading one of the options.

4.5. User experience

Designing and implementing the user interface and user experience (UI/UX) components appearance of the chatbot is entirely a job of a front-end developer, ensuring that it is user-friendly, visually appealing, and interactive. In a real project it will also be the responsible of integrating the chatbot into the target platform or website.

In the case of our chatbot, the user interface should be simple and intuitive. The user must know from the beginning what our assistant or bot is for, what type of questions or doubts it

solves and how to ask them.

Through an onboarding text, we directly teach the user the actions they can do in our chatbot as soon as they enter. It will also allow us to guide the conversation.

It is recommended to provide the chat with graphic content such as buttons, images, maps, etc., which help to improve the user experience. The chatbot can be combined with multimedia content, links to external sites or other client applications.

There are many resources that can be added with IBM Watson Assistant using no code. For example, showing videos, images or audio in order to have a more appealing answer.

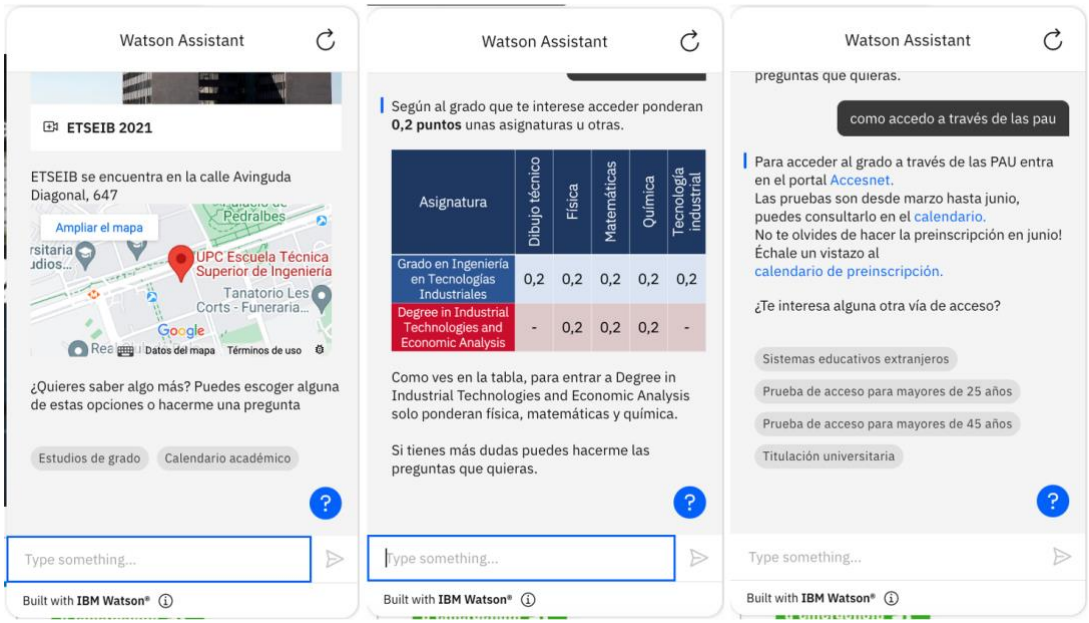


Figure 4.5.1. Examples of good practices of UI in the chatbot

As this is the first experience that the user is having with the university, is important what first impression is giving. If the university wants to be seen as modernized and technological the answer has to be accordingly.

4.6. Training

It is important to train the assistant with concise questions and the different synonyms a human person would use to ask the same thing. The questions of the different actions must be really differentiated between them, so Watson can have high percentages of certainty about the right action which the user is referring to.

This training is also continued once the assistant is used by real users, and it is known how

the users are asking for each action. It is also important, to keep checking the percentage confidence of each action once the project starts growing and actions can be similar to one another.

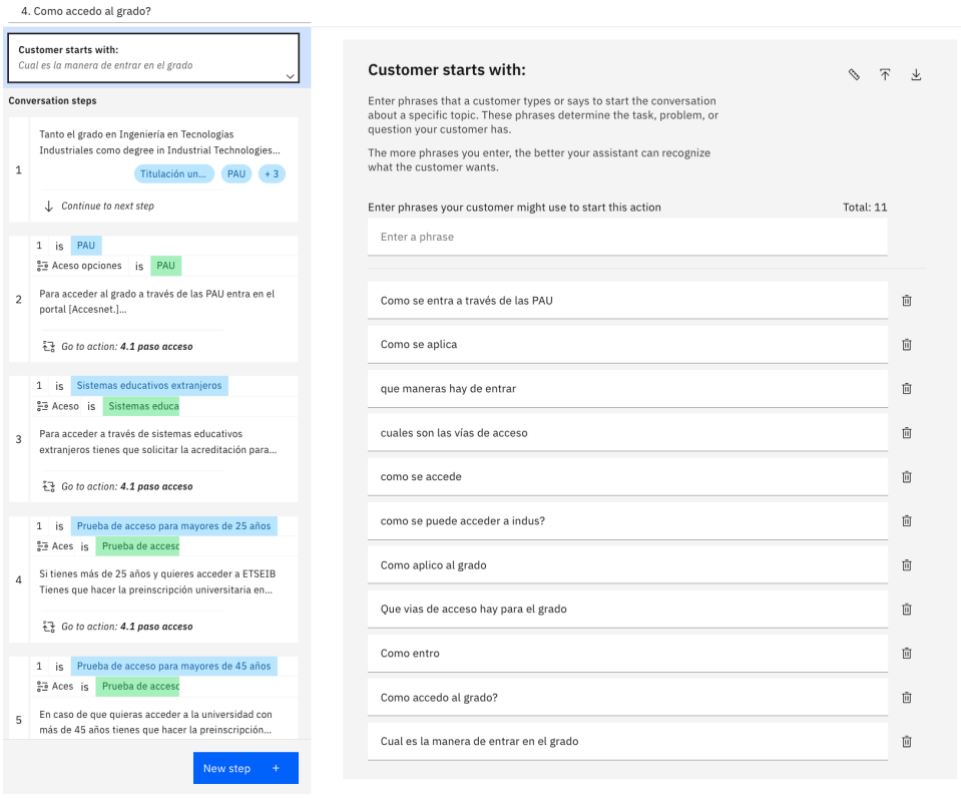


Figure 4.6.1. Example of training of an action

4.7. Production and tests

When all the dialogs are complete and the training is done, the last step is uploading the chatbot into the environment in which it will be functioning in order to do functional tests. There has to be tests done from people of the company and from a sample of the users that will be using the platform. The internal tests are done in an environment of pre-production and the tests from the users are done in the environment of production, which means the real site uploaded. The internal tests are usually performed by the consultants, but first the back-end developer has to integrate the chatbot into the website.

Watson assistant enables the two environments, “pre” and “pro” for the tests. I just have to upload the latest version of my chatbot and I can start doing the tests.

These tests are crucial in order to eliminate any bug that can appear to the users when they are using it.

To perform the tests that should be performed by the users I will experiment my chatbot with a sample of kids that match the target.

5. Experimentation and results

To experiment the chatbot with the users I asked a sample of kids to interact with my chatbot. I explained to each of them the scope of the project and the topics of the questions that are in the reach of the chatbot. I chose people that matched the target of my chatbot, that are people between 16 and 19 years old, that enter to ETSEIB's website looking for information about the degrees in order to decide whether to apply or not.

With Watson assistant I can have some insights of the interactions that the people are doing with the chatbot. I can take a look at all the questions that the people have asked, and how has followed the conversation.

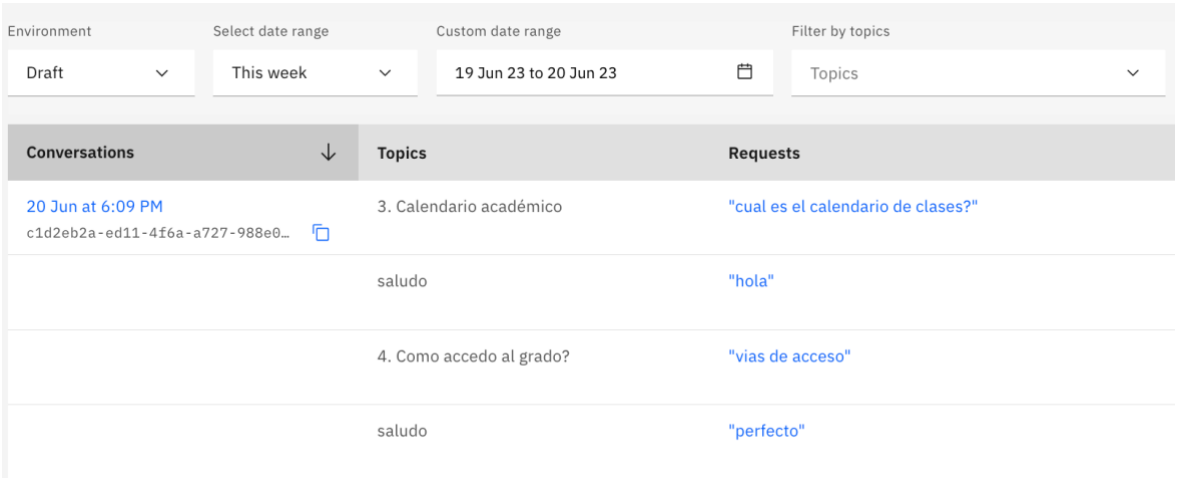


Figure 5.1. Conversation record

The insights that I need to answer from experimenting with this sample of people are:

- Did they do many questions out of the scope (even when they have been told which is the scope)?
- Which is the most common question? And least?
- How do people interact with the chatbot? Are they straight-forward?
- People prefer to follow the options or ask random questions?
- Which is the average number of questions before leaving the chatbot?
- If the chatbot does not understand them, does people paraphrase or pass?

- Why are people exiting the chatbot? Because they have found what they were looking for, or because the chatbot fails?

I also did some extra questions that were not directly observed by their interaction with the chatbot:

- Was the chatbot useful for you?
- If you enter into a webpage, would you use the chatbot?
- Has ETSEIBot cleared any doubt about choosing ETSEIB or not? Or what degree to choose?
- Do you think that the chatbots contributes to a more positive experience with the website and the university?
- Would you prefer a model like ChatGPT that answers every question, but the answer may not be reliable? Doesn't that make a customer service untrustworthy?

The experiment consisted on leaving the user 15 minutes to go through the website and search different things, then afterwards I introduced my chatbot and they had the opportunity to ask any doubt they had (inside of the scope) and then I asked them the analysis questions.

After doing the experiment this are the results that I obtained:

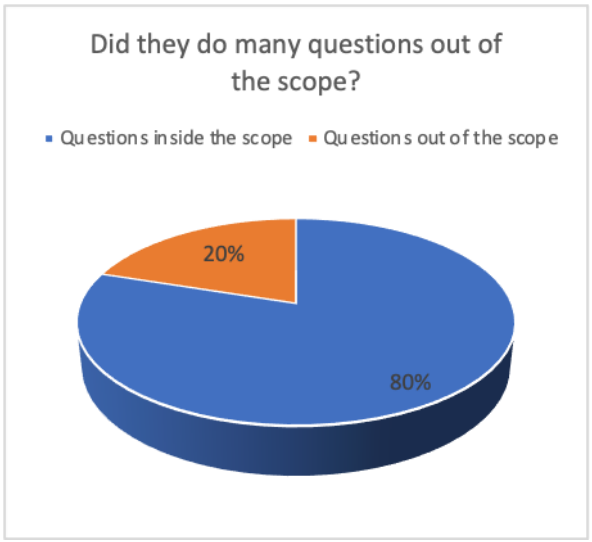


Figure 5.2. Percentage of questions in and out of the chatbot's scope

The results show that the chatbot has answered successfully the 80% of the questions. Which is a really positive result. Always taking into account that the people that was facing the bot was informed about the scope. But this didn't stop them to do some questions that were completely out of scope. For example, some questions that the chatbot received are: "Can I enroll into industrial design?" or "How many credits is System dynamics worth?". We can see that all the cases that a question has fallen out of the scope is because the topic was not one of the topics that I had previously trained.

Out of this question I realized that the chatbot should have an specific question for answers that were out of the scope, in order to inform the user of why the chatbot was not answering that question. Therefore, I added to action of "questions out of the scope" and gave and answer for when a question was not identified with any other theme, and responded that the questions was out of the scope, but in further improvements it would be added.

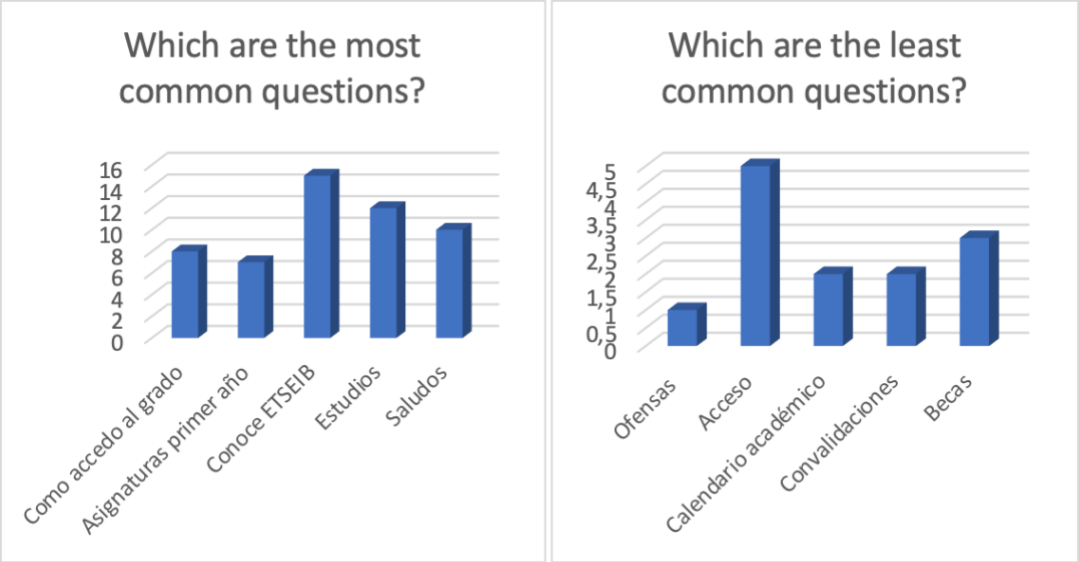


Figure 5.3. Most and least common topics

In the images above, it is shown that the most common question is "Conoce ETSEIB". My hypothesis is that this is because is the first option of the offered answers and people chooses the options that are displayed. As I wanted to build a proactive chatbot with the mission of "selling" the university, we can say that the strategy of offering options is great when you are interested on people interacting with a certain topic (for example in sales-oriented chatbots).

On the other hand, the less common question is the offenses one. I attribute this to the fact that the people interacting with the chatbt knew that it is a TFG and they asked for serious questions. But it is important to noticed that there is always someone that says bad words to the chatbot.

To answer the question of how does people interact with the chatbot, we can see that people tend to use long and elaborated sentences, rather than direct orders. More as if they were talking to a person than to a machine. Some people said please and thank you to the chatbot before and after the interaction. “What subjects are there in the first year of industrial degree” and “How can I access the degree through selectivity” “Thank you for the answer”.

Also, when going through the conversations the people has had with the chatbot we can see that people like to go through options that guides them through the answer. Maybe with a public that had real questions could have been different.

The conversations have lasted 2 or 3 different questions normally, it hasn’t been really common for the people to ask more than 3 questions.

There are few cases where the chatbot did not understand at first the question of the user, because it was a question out the scope, despite of that the user paraphrased the question in order to try to ask the same question in another way. The question kept falling with the answer of out of the scope.

I have seen that people leave the chatbot with no apparent reason. After two or three questions, some of them say “thank you, bye” and leave the chat. It doesn’t have to be specifically because the chatbot has failed. I don’t see any pattern in that matter.

In addition of analyzing the conversations between the user and the chatbot I wanted to perform some direct questions about the level of satisfaction and opinion of the chatbot. Collecting feedback from users about their experience with the chatbot can provide insights into user satisfaction levels. Understanding user sentiment and identifying areas for improvement can help enhance the chatbot's performance and can prepare the changes that can be implemented into an evolutive version.

The first question was about the usefulness of the chatbot. To sum up, the people that was involved in this experiment said that they found the chatbot to be useful. Because “it guides you through the content, extracting the most important things”, one said. They also argued that putting content into graphs or images is also useful to summarize the information. They found most useful some more specific questions that are not found directly in the website like the subjects that count from PAU or the comparative between the two degrees, that would have been more tedious to discover.

About the questions “If you enter into a webpage, would you use the chatbot?”, people responded that they don’t usually interact with the chatbot when they enter a webpage, because they don’t know their abilities and their scope. If they were to know the questions that the chatbot can answer they would use it. One resource that can be used with Watson Assistant is that you can set a time in which the chatbot shows a pop-up with a message to

attract the user's attention or to explain something. Although the message issued cannot be too long, it is a good opportunity to present and sell the abilities of the machine.

In order to measure the usefulness of the chatbot I asked them if the conversation they had with the chatbot helped them clear any doubt they could have about studying or not in ETSEIB, or what degree to choose. Some of them that were doubting between the normal degree and the one with economics said that they found it useful to compare between both degrees, and some people have even discovered its existence of the second degree through this chatbot. A minority of them argued that the fact that the tone sound like a friend or like an ex-student, made them trust more the chatbot and the university gained a sentiment of closeness.

To measure if the chatbot was improving their experience with the website and their point of view of the university, I asked them the following question: "Do you think that the chatbots contributes to a more positive experience with the website and the university?". The general answer to that question was that it added a more technological a modern view into the university, because they have heard about ChatGPT and the auge of virtual assistants, so it made the university seem to be more "updated" with the technological trends. Some added that it was fun and a pleasant experience.

Finally, I asked them one really important question: if they would prefer a model fed with all the available data on the internet able to respond to any question. With such a big amount of information revising every question and answer is impossible, therefore this type of chatbots have the risk of giving wrong or unreliable answer. Most of the kids answered that they would prefer a closed scope chatbot with a revised and custom-made material in order to trust and use the assistant.

In conclusion, the analysis of the chatbot's performance on the university webpage has provided valuable insights into its effectiveness and user interaction. The chatbot was able to successfully answer 80% of the questions, which is a positive outcome considering that users were informed about its scope. However, there were instances where users asked questions that fell outside the scope of the chatbot's training, highlighting the need to address such scenarios. Also, this approach of offering options proved effective in engaging users, especially in a sales-oriented context. It also seemed as a more modernized university, updated in the lasts trends.

The use of the experimentation and being able to analyze the conversations is crucial for the improvement and for adding new frequently asked questions into the chatbot's scope. This is part of the maintenance that should have a chatbot once is commercialized and in an environment of production.

6. Planning

In the following Gantt diagram, it is shown the tasks involved in the project and their approximate duration.

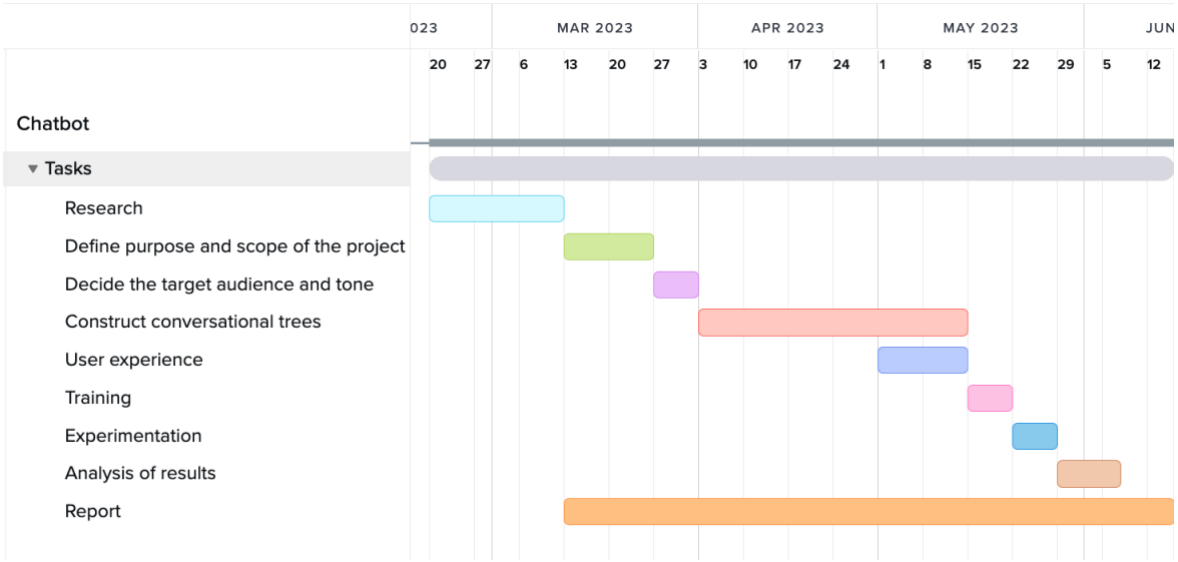


Figure 6.1. Gantt diagram

This Gantt diagram was elaborated with an app called TeamGantt (https://app.teamgantt.com/projects/gantt?ids=3575070).

7. Economic assessment

The economic assessment of this project consists of the computation of the total cost for its development. Considering human resource costs, material costs and indirect costs.

Table 4.7.1 Calculation of human resources costs

Human Resources	Hours	Unit cost (€/h)	Total cost (€)
Research	63	15	945
Define purpose and scope of the project	42	15	630
Decide target audience and tone	21	15	315
Construct conversational trees	122	15	1830
Design User Experience	10	15	150
Training	10	15	150
Experimentation (from me and students)	5	10	50
Analysis of results	27	15	405
Report	90	15	1350
Subtotal	**390**		**5780**

This project has been carried out by a single person, even though every task of the project would be done by different professionals in the case of being a real project of a company. As shown in Table 7.1., the human resource costs have been computed considering the approximate dedication in hours for the development of the project with a cost per hour of 15 €/h, corresponding to a graduate engineer and 10 €/h, corresponding to the students that were involved in the experimentation of the solution.

As I mentioned before, I used the chatbot framework IBM Watson Assistant, which has de option of using a free service.

Table 4.7.2 Calculation of material costs

Material	Quantity	Cost (€/quantity)	Useful life	Total cost (€)
Laptop	1unit	1219	4 years	152
Microsoft 365	6 months	5,6	-	34
IBM Watson Assistant Lite	1	0	Unlimited	0

Subtotal				**186**

The table below shows the indirect costs, that were not considered in any of the categories above. The cost of electricity could have been directly neglected because it is minimal. It has been calculated by multiplying the kW consumption (36 watts) by the total of hours of project using the computer (390 hours).

Table 4.7.3 Calculation of indirect costs

Product	Unit	Unit cost	Total cost (€)
Electricity	14,04 kWh	0,1638 € /kW·h[1]	2,30
Internet access	6 months	30 €/ month	180
Subtotal			**182,30**

[1]Data extracted from the price of kW·h of one electrical company.

Table 4.7.4 Calculation of total costs

Concept	Cost
Human resources	5780
Material	186
Indirect	181,52
Total cost	**6147,52**

The total cost of the project considering all the monetary aspects has been approximately 6147,52 €, for a project that has lasted 6 months. Adding the corresponding VAT of (21%) gives a value of 7438,5 €.

8. Environmental assessment

In a society where sustainability is gaining increasing importance and there is concern on minimizing the impact of human activities on the planet, it is interesting to consider the environmental impact in the development of any project. In this case, energy and water consumption are the main factors that can have an impact on the environment.

It is possible to approximate the calculation of the energy consumption, an estimation of the power consumption of the equipment used in the Project. As it was calculated in the previous chapter the consumption of a laptop it is approximately of 36 W, multiplied by the 257h of usage gives a total of 9,25 kWh.

Energy consumption can be traduced to the equivalent amount of greenhouse gases emitted (kg CO_2eq). This is computed as:

$$9{,}25 \text{ kWh} \cdot 259 \text{ g } CO_2\text{eq/kWh} = 2396{,}27 \text{ g}Co_2\text{eq} = 2{,}396 \text{ kg}Co_2\text{eq}$$

Another approach to assess the environmental aspects of the project is to define the positive and negative impact it will have the implementation of my project in a big scale.

8.1. Positive impact on the environment

Infrastructure Efficiency: Utilizing cloud-based hosting solutions and virtualized servers (removing all physical customer service locations) optimizes resource utilization, resulting in reduced energy consumption of light, conditioning systems, computer support…

Reduction of waste: By providing digital assistance and information, the project reduces the reliance on paper-based communication and use of other resources like pens, leading to a decrease in paper waste.

User education: the chatbot could have a message or an answers programmed to educate users about the use of virtual assistants and the positive impact in the environment of communicating with an online virtual server.

8.2. Negative impact on the environment

Data Centers: If the virtual assistant is hosted in data centers, their environmental impact, such as energy consumption and cooling requirements, should be taken into account. Although there exist more consuming and less coding systems.

Software Updates: Regular software updates may require additional energy consumption and server resources. Efficient management of updates can help minimize the environmental impact.

9. Social and gender equality assessment

Regarding the social and gender equality, the most important topics to discuss are if the solution does any type of social or gender discrimination and if the implementation eliminates any present discrimination in the field.

It can be concluded that the technical solution doesn't discriminate neither men or women, because all the answers are designed in a neutral way, without making any generalization or leaving any collective unrepresented. The technology is prepared to be easy to interact with, so people without expertise in technology can use it.

This version it is not yet prepared for different languages, in that sense it would be a lack of the chatbot. In a second version of the chatbot it could be integrated with google translate or ChatGPT (for example) and hold different languages. The user could speak in any language, Watson would send the message to translate and then it would process all the information in Spanish, choose the tree, and return the answer in the needed language.

The fact that the chatbot responds in a neutral way, it doesn't give information if the "assistant" that is responding to you is masculine of feminine, unlike in a phone call. So it also eliminates the association of an specific gender to the role of assistant.

On the other hand, it is necessary to have access to an electronic device in order to interact with the assistant, which can be an issue for some vulnerable groups.

I consider that this project contributes with the objective of dignified work and economic growth, because it teaches a machine a job than can be mechanized that was being performed by a person. This person can now focus on doing something more challenging, or on answering more specific questions that cannot be typified, and improving the quality of its work, instead of trying to give answer to all the questions or even leaving some unanswered. At the same time, the UPC can allocate the money spent in the salaries in another area with the need of development, and consequently give a better-quality education.

Figure 9.1 ODS accomplished in this project

Conclusions

In conclusion, the main objectives of this project were successfully achieved, focusing on the development of a virtual assistant powered by IBM Watson Assistant to enhance the user experience on the university webpage. Even though this test has been made with by developing only a proof of concept with a limited scope, the virtual assistant effectively addressed user inquiries, providing personalized assistance and guiding users through the webpage content.

This can be seen with the high rate of success of the answers when analyzing the interactions. It could be said that the effectiveness of the chatbot also contributes to the objective o automating routine tasks, such as providing general information and handling frequently asked questions, reducing the workload on the university's call center staff and improving overall operational efficiency.

Additionally, a significant achievement of the project was the design of a solution using freely available online tools, highlighting the accessibility and affordability of creating a chatbot from home without the need for expensive training courses or programs. As we can see that the chatbot is functional and could be integrated to ETSEIB’s website using the embedded code available.

Collaboration with university staff and students played a vital role throughout the project, ensuring user testings. This collaborative approach ensured that the virtual assistant effectively addressed the needs and expectations and could be in constant improvement adding different points of view.

Overall, the project's outcomes contribute to enhancing the user experience on the university webpage, improving operational efficiency, and leveraging data-driven insights to make informed decisions for continuous improvement.

It has to be said that the scope of the project has been fairly limited and there are plenty of areas that could be expanded and escalated. In the next chapter I address some limitations that I have faced and some future working lines that could be followed for further improvements.

Limitations and future working lines

Limitations

The limitations that I have encountered when doing this project have been the following:

Lack of prior knowledge about the Watson tool: as it was a very specific job that has been done with a new tool for me, it has taken me a long time to learn how to use the program and that my time using it was optimal, since I had to make some test prototypes, before consolidating the final version.

Lack of technical knowledge of programming: due to my limitation with programming and lack of time, I have exploited more the functional, usability and business part of the project, since it is the field that I would like to dedicate myself to, now that I am starting to work.

Lack of diversification of tasks: as I explained in the planning methodology section, this project in a company would be carried out by a sum of 5 professionals, since each one would take care of a part and would specialize in something. For my part, having to carry out all the functions has prevented me from specializing and mastering all the fields. I have focused on the work of creating the conversational trees, which a developer consultant would do.

Future working lines

I attach a code script of my project in json format (the format in which is downloaded from Watson Assistant), in order for someone to use it to continue the chatbot from the point where I left it, or to test and discover IBM Watson. It is only necessary to create an IBM Cloud account and upload the json file.

To present the future working lines that has my project, I will be explaining which phases could be continued and expanded and how:

Scope of the project and target audience: in a second version of the project there can be an expansion of the scope and the questions addressed, adding more questions into the chatbot and adding the master's information. The user that is facing the chatbot could identify if it is interested in degrees or masters and enter different trees, it could even be differentiated into two bots. Also, it could be interesting to do two different trees to respond to future students and to those that are already enrolled in university. As ETSEIB's website has a portal to identify the user, that information could be used to offer a more personalized treat to the user. This second version of the chatbot doesn't have to be so proactive, and would

follow more the requests of the student.

Construct the conversational trees: in case that the volume of the responses would increase or that another language is incorporated we would need to start using a data base. The data base should be connected using an orchestrator that would send the request of Watson either to the translator or to the data base. When the answer is found in the data base, in the right language it is send back to Watson by the orchestrator and it will give an answer.

Incorporate more languages: to add more languages into the capabilities of the chatbot, it should be integrated with a translator in order to first detect the language and then translate the question of the user into the language in which the program is trained. Then, Watson would identify the question and enter into the respective tree. As the answer could contain media, pictures or figures in another language, it wouldn't be enough just to return the answer to the translator and showing it in the chat, but instead, the answers would have to be allocated into a data base with different content depending on the language and different codes. Then according to the identified language returns one answer or the other. To incorporate this functionality Google translate or ChatGPT are some alternatives.

Integration into ETSEIB's website: in an evolution of this project, the chatbot could be integrated with etseib's website in order to make it functional. To embed the chatbot into a website, Watson assistant offers a code.

Maintenance: If the project is applied in a website it requires a periodical maintenance as well as analysis to improve the service and actions in front of incidents. Some of the tasks that must be carried out during maintenance are:

- Monitor and review that the technical services have not fallen.
- Daily analysis of the conversations and the metrics set by the client.
- Review the responses offered to the clients
- Uploading into the production environment the modifications to the questions made by the client
- Functional tests

Support users with disabilities: some functionalities as text-to-speech, speech-to-text, user-friendly interface or supporting multiply languages would ensure that all users can easily access the information and services available on the university webpage.

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Project repository

The chatbot can be accessed through this link.

https://web-chat.global.assistant.watson.appdomain.cloud/preview.html?backgroundImageURL=https%3A%2F%2Feu-gb.assistant.watson.cloud.ibm.com%2Fpublic%2Fimages%2Fupx-c7784cf2-5a09-479c-ad12-d853a06c6989%3A%3Adceff08f-fb63-4f70-887c-3409a2309002&integrationID=b00c3b5f-c215-4f59-abb2-9db59cbf58c6&region=eu-gb&serviceInstanceID=c7784cf2-5a09-479c-ad12-d853a06c6989

Remember that the chatbot covers the following topics:

1. **What is ETSEIB:** Video introduction to ETSEIB and map with address of the school.

2. **Information about the available degrees:** Information about *Grau en Enginyeria en Tecnologies Industrials* (duration, credits, teaching type, mark to enter, number of people), information about Bachelor's degree in Industrial Technologies and Economic Analysis (duration, credits, teaching type, mark to enter, number of people), comparison between general information of both degrees.

3. **Information about the academic calendar**: link to academic calendar, first period calendar, second period calendar, Bachelor's degree in Industrial Technologies and Economic small specifications.

4. **How can I access the degrees:** students with PAU, students of foreign educational systems, students with the access test for more than 25 years, students with the access test for more than 45 years.

5. **Can I validate subjects**: different ways of nonvalidating subjects.

6. **What subject count for entering to the degree:** comparative table between both degrees.

7. **What scholarships exist?**

8. **How is the schedule for the first year?**