Chatbots for Cultural Heritage: A Real Added Value

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Abstract: During the last few years, a lot of research work has been done on developing of chatbots that can support humans in different functionalities. The role of a chatbot cannot be limited to being an important virtual assistant to its users but can be exploited by organizations and governments as an adaptive application for the promotion of certain sectors of the economy, such as tourism and cultural heritage (CH). In this paper, the authors present a theoretical and historical background, then discuss the use of chatbots in the CH domain, and finally describe the basic steps and challenges of programming a chatbot taking advantage of the advances in machine learning (ML), deep learning (DL) and semantic web (SW) technologies.

1 INTRODUCTION

A chatbot is a computer program (web, mobile...) designed to interact with users using text or voice so that the user thinks they are interacting with a human. To achieve this result, the use of machine learning (ML) algorithms is essential. Older techniques involved create an illusion of intelligence by implementing much simpler techniques for matching and processing strings for interaction with users, using rule-based and generative models. These techniques suffered from many problems and found it difficult to respond reliably to user queries. However, with the emergence of new machine learning technologies, much more autonomous and especially more intelligent systems have emerged. A text or voice conversation is usually initiated by the main actor, who is the user who formulates a question in natural language, and the chatbot provides an answer in natural language. It was one of the initial issues that gave rise to Artificial Intelligence (AI) technology, and its advancement has had a significant impact on the development of Chatbots that can interpret and process a human's enquiry. Artificial Intelligence Markup Language (AIML), which is built from Extensible Markup Language (XML) and is used to artificially build a chatbot, is valuable in this regard (Satu et al, 2015). The authors present a brief overview of some applications that have used AIML for their conversational service. These applications are related to cultural heritage, e-learning, e-gov, and many other fields. In the field of cultural heritage, chatbots are a new area to explore, given the low number of initiatives aiming at developing this field despite the stakes it presents, especially in the development of the economy and tourism. Indeed, we might see a chatbot that automates the work of guiding users and tourists interested in a region's cultural heritage assets. This will provide a first idea on the richness of this heritage, then assist the user in repetitive tasks that previously consumed time and energy and that can now be delegated to software to save time and respond to a maximum number of people.

The number of research papers in the subject of developing generic or domain-specific virtual assistants continues to rise year after year. This is demonstrated in Figure 1, where a simple search of the SCOPUS database reveals a considerable increase in the number of research papers on chatbots. Unfortunately, few of these works are tied to cultural heritage, which is why the research presented in this paper is so interesting.

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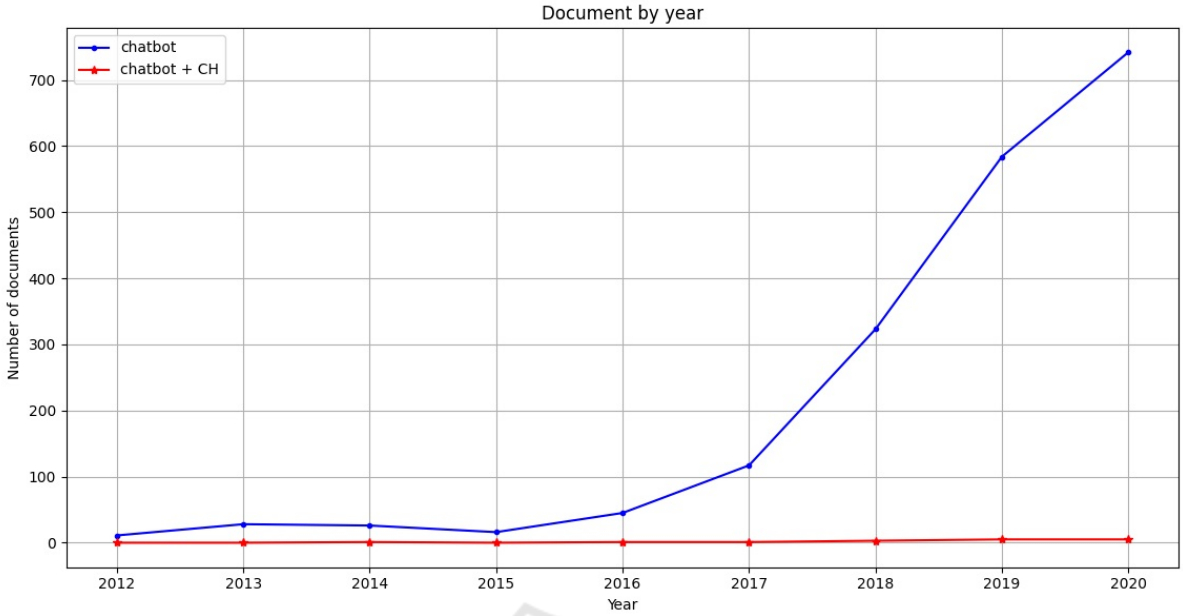

Figure 1: Number of documents about Chatbots and CH according to the SCOPUS DB

Several questions have motivated us in this work to move towards a chatbot for cultural heritage:

Q1: What goals will the chatbot address?
Q2: Is it heavily used in the CH domain?
Q3: Which sectors of the economy will be affected?
Q4: What type of bot should I choose?
Q5: What problems should the chatbot solve?
Q6: Who are the potential users?
Q7: How to structure the conversational flow?
Q8: How to build a sufficiently rich knowledge base?

Chatbots in the field of CH raise challenges that are comparable to those in other fields. Other challenges related to this area may emerge, indicating how conversational agents can give significant added value, depending on the sections of the heritage covered. Companies have established indices in the commercial domain that allow them to evaluate the influence of a chatbot on the company's everyday operations in terms of turnover. Based on these indices, managers can determine whether or not to install a chatbot to support a portion of their job and activities. Because prototypes are already in place and can be customized to individual scenarios, developing a chatbot is no longer a problem. This saves time and allows decision-makers to reap the advantages much faster.

In the sector of cultural heritage, we are also beginning to gain from these services, but there are some challenges that must arise owing to the complexity of heritage data. An overview of the design and implementation of a pilot audience development project involving four museums in Milan, Italy is provided in this case study. A promising initiative that visualizes the narrative utilizing a convergence of chatbot and gamification platforms combining the latest artificial intelligence (AI) technology in order to find new and fascinating methods to engage adolescents in visiting museums and art galleries. (Gaia et al, 2019)

2 HISTORY OF CHATBOTS

The first chatbot in history was launched in 1966. It's a program called ELIZA, which was created by MIT scientist Joseph Weizenbaum. ELIZA uses a keyword recognition system to rephrase patients' statements into interrogative form, simulating a psychotherapist. The Jabberwacky program, created in 1988, simulates a discussion in genuine human language in an interesting and enjoyable way. ALICE is unquestionably the precursor of chatbots (Artificial Linguistic Internet Computer Entity). ALICE is a computer program that was created in 1995 that can simulate a beneficial conversation with a human. It has an identification system that is adapted to the personality of its interlocutor, as well as a larger information base.

Watson was invented by IBM in 2005. Watson is able to answer questions expressed in natural

language because to the newest artificial intelligence technologies. Apple (Siri), Google (Google Now), Amazon (Alexa), Microsoft (Cortana), and Facebook (Messenger) all joined the dance in the early 2010s, launching their own natural language user interfaces. We can construct conversational bots for Facebook users to connect with via Facebook Messenger, for example. This new ability to create a chatbot will result in their massive democratization.

3 RELATED WORKS

Chatbots have been developed to overcome communication barriers in a variety of fields. One of the most important is cultural heritage. Chatbots are a solution to employ as virtual assistants that answer exactly to user queries at a lesser cost. In the cultural heritage area, the usage of virtual assistants can have a considerable positive impact on the preservation and enhancement of a region's heritage. Despite the significant stakes that it may offer, especially in areas such as tourism, research and development work on chatbots applied to heritage monuments remains insufficient. In (Pilato et al, 2005), a chatbot system for the cultural heritage domain is presented. This system employs knowledge bases based on a semantic approach, allowing them to assess their own expertise in relation to the user's questions, which are all mapped in the same semantic space.

A conversational agent would frequently employ a vast database of questions and answers to train the end system to respond to user inquiries automatically. These databases can be done manually or using publicly available data. This may bring us to another issue that may have an impact on the system's quality: the redundancy of the questions/answers. There are a number of methods available to help solve this challenge and arrive at a full data source with no redundancy and enough questions and answers for the learning stage (Nafis et al, 2015)

The authors in (Duguleană et al, 2020) offer an intelligent conversational agent for increasing museum information accessibility. Using NLP approaches, the generated intelligent virtual agent communicates with users. In (Lombardi et al, 2019) the authors aims to take use of Italy's enormous number of archaeological sites by creating a Chatbot that can provide tourists with the relevant information at the right moment. Through semantic analysis of archaeological data, this Chatbot should be able to provide users with contextual information. The goal of (Casillo et al, 2020) is to propose a recommendation system that may create a personalized tourist itinerary for some of Campania's most important cultural attractions. According on the tourist's profile and contextual factors, this system recommends sites of interest and related services. The user interacts with the system using a chatbot, which allows for a real conversation. Because the final aim of a user in both cases is to have relevant information that answers a defined query, chatbots and recommendation systems can often support each other (Atzori et al, 2017). Chatbots act as human guides for users, and recommendation systems are helpful tools for leading them to suitable services and products. The purpose of both systems is to understand and meet the user's demands (Nafis et al, 2020).

In a similar spirit, the authors of (Lombardi et al, 2019) present a Chatbot system capable of providing contextual information to tourists visiting archaeological sites in Italy, based on a semantic analysis and the implementation of a recommendation system that can provide users with automatic assistance.

It should be noted that the social and affective aspects of the human and chatbots interaction have progressed significantly in recent years, proving to be enjoyable for users and having a favorable impact on the participants' perceived well-being. This is most likely due to the features established in a chatbot that support relationship building, such as acceptance, understanding, and non-judgment (Skjuve et al, 2021)

4 BASIC FUNCTIONALITIES

Conversational agents can be classified according to several criteria (Hussain et al, 2019). The most important criteria are (Figure 2):

- Technology employed: ML and DL algorithms, artificial intelligence, semantic Web technologies such as linked data, ontologies and RDF graphs, AIML, etc.
- Domain of knowledge: general or specialized field
- Requirements: functional requirements are or are not necessary.
- Final objective: oriented conversation or not
- Approach used: Rule-based, Retrieval-based, or Generative based.
- Interaction method: vocal or text conversational agent
- GUI: Web, mobile, etc.

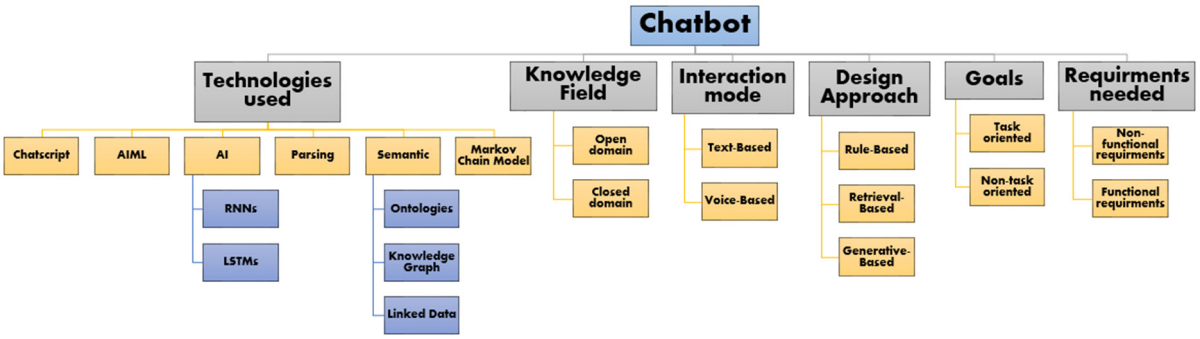

Figure 2: Classification of conversational agents

Other criteria could be used depending on the context of implementation and the scope, but the majority of the criteria used in the literature can be summarized in Figure 2.

Figure 3 presents the general architecture of a conversational agent operating in the cultural heritage domain. Other functionalities can be added depending on the context and on the expected purpose and results. A user provides a request through a mobile device or through a web interface. An API receives the request and processes it through ML and DL algorithms that will use already stored data sources to answer the request. For each user response, feedback can be received to measure the degree of satisfaction with the given answer in order to make updates or confirm the answers for subsequent users. The question and answer are automatically added to the data source to enrich it. The API parameters are continuously modified to improve its performance and reliability. From time to time the data source is enriched with a set of SCH data with well-chosen questions/answers. This can be used with the help of semantic web and Linked Data technologies to assign a semantic layer on the manipulated data (Nafis & Chiadmi, 2016). This addition is the responsibility of one or more domain expert administrators who play the role of user and admin, testing the different features of the chatbot and then writing reports on each feature developed. Then feeding the data source with objects and questions/answers on the SCH to run the machine learning algorithms that will be used later. (Dimitris et al, 2019)

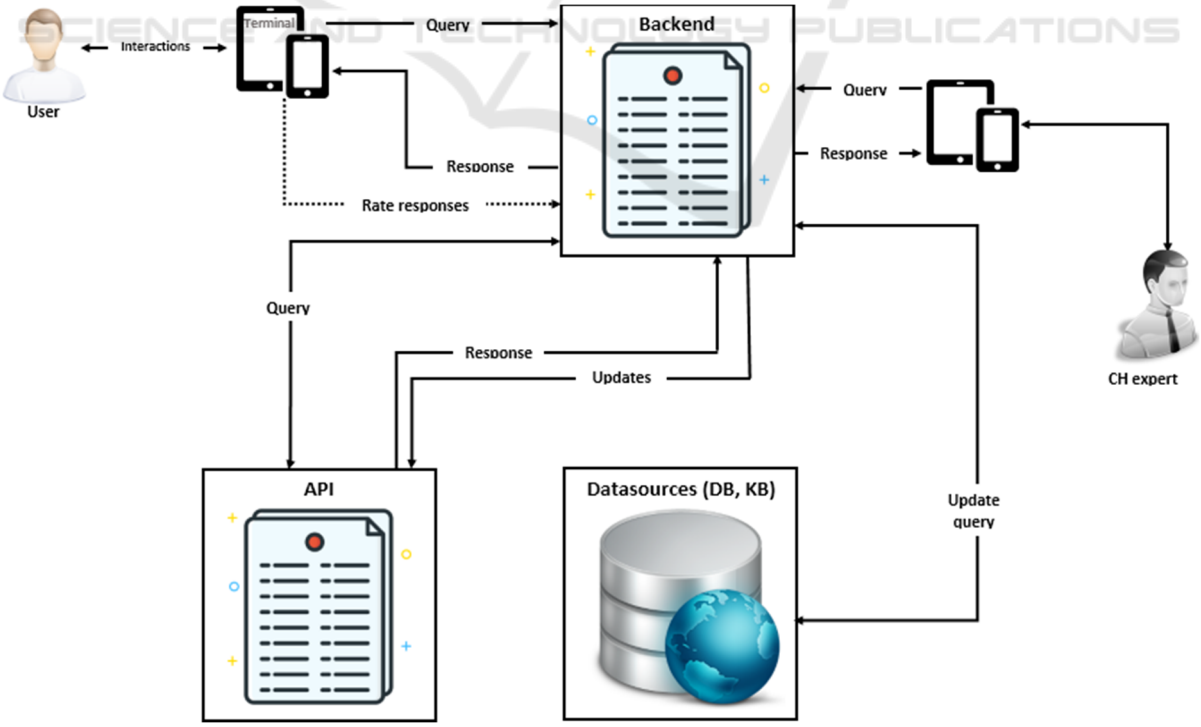

Figure 3: General architecture of a conversational agent

5 CONCLUSION

This paper conducted study on the employment of conversational agents to conserve a region's cultural heritage. The architecture of a chatbot functioning in the CH domain has been given as a generic architecture. Implementing and testing a chatbot to communicate the study region's rich cultural heritage will be a promising project. The criteria for selecting and developing appropriate technology will definitely serve as a foundation for a successful first experience with the region's cultural heritage. Several areas of the local economy, such as tourism, will benefit as a result of this. The next step will be to present and develop an architecture for a conversational agent specializing in the research region's scientific cultural heritage. There will be a comparison of the results acquired with those of other chatbots in the domain.

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