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Chatbots in E-learning : Advantages and Limitations

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ABSTRACT: The application of artificial intelligence in the educational field has increased significantly in the last decade. In fact, several works are carried out in order to implement smart systems to help learners in their learning processes. Chatbot is one of the AI solutions used to capitalize tutor knowledge and transfer it to learners. Its main feature is to interact effectively with human requests using natural language processing tools, which enables it to understand human intent and respond by text or voice. As a sequence, the chatbot improves the efficacy and productivity in the education domain. Our work aims to identify, collect, and synthesize numerous works from multiple research studies on the use of chatbot in the education field.

In this paper, we studied the main research that focuses on the use of chatbot in education. Then, we make a comparative study to highlight research gaps and open new windows for guiding our future works in this area.

Keywords: Artificial Intelligence, Chatbot, Education, Learning.

1. INTRODUCTION

In recent decades, Artificial intelligent technologies have succeeded in developing a wide range of domains, especially Elearning which is the focus of our study. In fact, several tools have been implemented to enhance the learning process.

Chatbots are among the AI wide used tools which offer an increasingly options to help learners improve their knowledge, by understanding their intents and responding efficiently and effectively to their questions. Several works have focused on the use of chatbot in the education field and many implementations are used all over the world.

The purpose of this paper is to study various researches on the use of chatbots in the educational field, in order to synthesize and retrieve some perspectives of improvements.

The remainder of this paper is structured as follows: The next section explains the main concepts that are used in this paper. The third section represents the results of the study, the fourth section discusses the results funded, and the last section provides the conclusion and future work.

2. MAIN CONCEPTS

In this section, we introduce three core concepts: “Artificial Intelligence”, “Chatbot”, and “Knowledge base”.

2.1. Artificial Intelligence

Artificial Intelligence is a branch of computer science which consists of implementing some techniques in order to allow machines to imitate a real form of intelligence. AI is being implemented in a growing number of fields of application.[1]

Machines equipped with artificial intelligence memorize behaviors. This memorization work allows them to Solve problems and to act correctly in a given situation.

This learning is done with the help of databases and algorithms.

This complex work helps the machine to measure the importance of a problem, to screen possible solutions and similar past situations in order to act correctly[2].

AI technologies are various : Natural Language Generation, Speech Recognition, Virtual Agents (Chatbots), Machine Learning, AI-optimized Hardware,. Deep Learning..etc [3].

2.2. Chatbot

Historically, the first chatbot named Eliza was created in 1966 by Joseph Weizenbaum, a professor at MIT (Massachusetts Institute of Technology), in the United States [4]. The program, which simulated a Rogerian psychotherapist, reformulated most of the statements of its interlocutor into questions that it asked in return.

The chatbot or the virtual assistant, is a computer program that simulates a conversation with a person, either written or spoken [5]. When a user asks in the conversation a question or formulates a command, the chatbot will answer or execute the requested action.

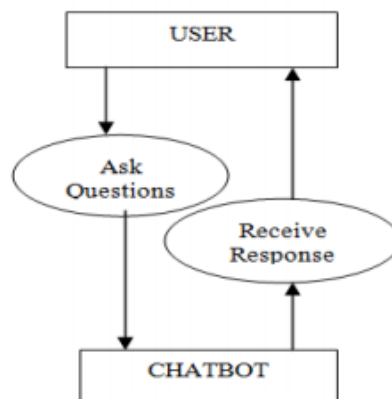


Figure 1 : Use Case Diagram of Chatbot Design

Basically, the chatbot works by relying on a Knowledge Base which is a collection of questions and their answers that are triggered based on certain keywords spotted in the conversation. However, advances in artificial intelligence, and more specifically in machine learning, have made it possible to create much more advanced conversational agents. This evolution is due to the adoption of current natural language analysis systems that are powerful and capable of self-improvement. [6]

2.3. Knowledge base

The knowledge base is the brain behind the chatbot, it stores and centralizes all available knowledge. Well-designed knowledge base enables the chatbot to understand user requests, improve its ability to respond correctly to user inputs, and interact effectively by giving the appropriate responses. [6].

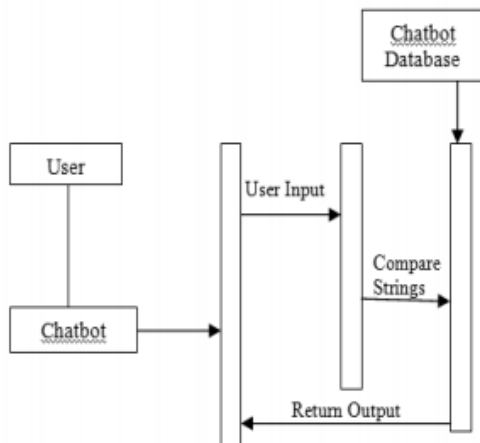


Figure 2: Sequence Diagram Representing Design of the Chatbot.

3. RESULT OF THE STUDY

Given that chatbot positively impacts a wide range of domains (Medicine, Commerce, Finance, Telecom ...etc.), it's clear that E-learning will not be the exception.

In this section, we will present some research that focuses on the use of the chatbot in the educational field, evaluate them and compare their approaches.

The approach proposed in the paper Extracting Chatbot Knowledge from Online Discussion Forums, made in 2006 by Jizhou Huang, Ming Zhou, and Dan Yang [7] focus on the use of the data available in an online

discussion forum to construct the chatbot knowledge base by extracting answers, structuring and ranking them using a ranking SVM, and store the top classified answer as a chatbot KB.

Moreover, the extraction process proposed in that paper allows to collect a very large KB automatically which saves time and helps chatbot to enhance its ability to interact with users by learning from the diverse replies available on the KB. However, the Chatbot KB is limited on the previously extracted discussions which makes the KB not up to date.

In this context, another study made in 2018 by Shafquat Hussain and Athula Ginige [8] propose to extend the knowledge base of a conventional chatbot beyond its local knowledge base to external knowledge source Wikipedia by using Media Wiki API to retrieve information when the Chatbot's local KB does not contain the answer to user query. On one hand, the use of an external source enhances the analysis ability of the chatbot and allows it interacting with users correctly but on the other hand, using wikipedia as the only external source, makes the chatbot KB limited, it's better to use more than one external source in order to improve the interaction ability of the chatbot.

In addition to that, A Process for Extracting Knowledge Base for Chatbots from Text Corpora [9] was proposed in 2019 by Aliane Loureiro Krassmann, João Marcos Flach, Anita Raquel Cestari da Silva Grando, Liane Margarida Rockenbach Taroucou and Magda Bercht. The paper presents a process for extraction of AIML chatbot KB from text corpora using the AGATA (Automatic Generation of AIML from Text Acquisition) system, developed to facilitate and reduce the time needed in that task. The process proposed in this paper allows improving the chatbot KB and allowing corpus of various languages and structures to be easily converted into a knowledge base for AIML chatbots without requiring sophisticated NLP techniques. Nevertheless, the extraction process of the Chatbot KB is semi-automated, because it requires the evaluation of the expert in several steps of the process, which consumes time. Also, The chatbot Kb is fixed and limited on the extracted content.

In 2017, two projects have been launched on the use of chatbots in the educational field, the first one was a chatbot for university related FAQs [10], proposed by Bhavika R. Ranoliya, Nidhi Raghuvanshi and Sanjay Singh. It is a chatbot based on AIML language for Manipal University to answer the most asked questions about the university. It provides responses at any time that will help curious students to know all information about the university. But, the chatbot KB is limited to the answers already stored on the KB.

The second one was created by Menal Dahiya [6], it's a simple chatbot to answer frequently asked questions from visitors of the university. Its KB is created based on the AIML language.

The proposed chatbot provides responses at any time that will help curious students to know all information about the university, but the chatbot knowledge base is limited to the answers stored manually.

In the same logic, in 2020 the polytechnic university of Madrid, has implemented a Data Science Chatbot named "JAICOB"[11], it consists of developing a conversational agent to facilitate learning in the field of Data Science through Machine Learning algorithms and cognitive computing. It allows learners to discover the knowledge related to the mentioned field. The chatbot was evaluated with a sample of students, achieving very favorable results in usability and originality. Also, the module implemented to handle Small talk improves the bot's human likeness and makes it more fun and engaging, but, the construction of the chatbot KB is made manually which is time consuming, and the kb is limited on the content already extracted.

Among the studies carried out on the use of chatbot in the educational field, in 2018, a Survey on Chatbot Design Techniques in Speech Conversation Systems [12], has made by Sameera A. Abdul-Kader and Dr. John Woods to present the main techniques and approaches for creating chatbots (Parsing, Pattern Matching, AIML language, Chat Script, Sql and relational database, Markov Chain, Language Tricks, Ontologies), and compare a list of chatbots that have won the Loebner prize. The study shows that the development and improvement of chatbot design is not grow at a predictable rate due to the variety of methods and approaches used to design a chatbot, in addition to that, the chatbots designed for dialogue systems in the selected studies are in general, limited and they need improvements by designing more comprehensive KB. Also, in 2020, Pavel Smutny and Petra Schreiberova in their paper: Chatbots for learning: A review of educational chatbots for the Facebook Messenger [13], that educational chatbots on the Facebook messenger platform vary from the basic level of sending personalized messages to recommending learning content. Results show that chatbots are still in their early stages to become artificial intelligence teaching assistants.

4. DISCUSSION

The techniques used to develop educational chatbots are various, as presented above several works have been launched to enhance the efficiency of educational chatbots. For example, the chatbot of manipal university [10], the chatbot developed by Menal Dahiya [6] and "JAICOB" for the polytechnic university of Madrid [11]. These chatbots give learners the information searched, and help them in their learning process.

Despite that, the proposed methods in these chatbots are still limited because of the small size of

knowledge stored in the chatbot. Since the chatbot KB plays a very important role to improve the interactivity of the chatbot, several templates have been implemented to match user inputs and generate responses, but it is difficult to adapt the chatbot knowledge base to all users' input. In this context, several works are carried out to enhance this Knowledge base by adopting different approaches and techniques. For example, extending the chatbot knowledge base by automating its extraction from Text corpora [9] or from an online discussion forum [7] or by using an external source to support the chatbot knowledge base [8].

Despite this, two studies [12] and [13] show that educational chatbot are limited and they need an improvement to enhance their ability to handle conversations with users correctly

The papers presented in this review positively impact the improvement of educational chatbot by automating the extraction process of a huge size knowledge which can't be done manually [7] and [9], extending the chatbot KB to external source [8] which enhance the interaction ability of the chatbot.

However, there are some limitations in the chatbot knowledge base, which are presented as follows:

- The chatbot KB is fixed on the knowledge already stored [6], [7], [9], [10] and [11], which can negatively impact chatbot answers, by giving information out of date to users.
- The chatbot KB is limited to one external source [8], which is not enough to satisfy the majority of users requests.
- Manually extracted knowledge bases is time consuming, and difficult to adapt to all users requests [6], [10] and [11].

5. CONCLUSIONS AND FUTURE WORKS

Over the last few years, chatbots have become used to satisfy the academic needs of the learners, help them to enhance their knowledge, and automate tutor learning tasks.

The Aim of this review is to identify, synthesize and compare between existing chatbots in the education field. The review has considered that chatbots are an effective way to interact with learners and transfer the knowledge to them. and several works are carried out to enhance the use of the chatbot in this domain.

In spite of that, the effectiveness of chatbots depends on a variety of factors, among others, the chatbot knowledge base which plays a crucial role to improve the efficiency of the chatbot, in fact, chatbot can't respond correctly to learners request if its knowledge base is limited, which is the key source to improve the interaction with users.

As a future work we can extend the chatbot knowledge base by using several reliable external sources like encyclopedia, Website and Forums to retrieve knowledge on real time and send the answers to users

which enables the chatbot to update its knowledge base, made it rich and save time.

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