

# ARTIFICIAL INTELLIGENCE CHATBOTS FOR LIBRARY REFERENCE SERVICES

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## ABSTRACT

*The digital based world is very competent in the use of cutting edge, innovative technologies in various fields. It covers every area, from higher education to information resources. The aim of this study is to identify the potential of applying artificial intelligence chatbot applications to library reference services. This paper systematically reviews and explores the integrated applications of artificial intelligence chatbots into academic library reference services in order to cater to the demands of millennial users. The researchers discuss the benefits and the potential impact of artificial intelligence chatbots on the reference services of academic libraries. The artificial intelligence chatbot features in the reference services to enhance the library commitment of the millennial users with library services. This study discussed the benefits of artificial intelligence chatbots in reference services of academic libraries in general and especially in Bahrain.*

**Keywords:** Artificial Intelligence; Reference Services; Academic Libraries and Chatbots.

## INTRODUCTION

In the era of the industrial revolution 4.0, the technology industry has emerged to provide better services to its stakeholders. Artificial Intelligence (AI) is one of the prominent emerging technologies in the recent years. AI chatbots have become widespread in various sectors of life, especially, education, banking, health, and many other fields (Nawaz & Gomes, 2019). Service sectors have leveraged the strength of chatbots in their services. Chatbots are considered as effective information delivery tools which are used in digital environments. Academic libraries have long been providing reference services to the academic community in order to fulfil their information needs. We explore how AI chatbots can be used in order to strengthen the traditional reference services of academic libraries especially in catering to the millennials in Bahrain.

People are more engaged in the usage of messaging applications than other network-based tools. Since messaging is one of the core functions in the mobile experience, AI chatbots are more relevant to the same. There are many benefits of using AI chatbots in reference services in academic libraries. One benefit is that users will be able to have conversations in a natural and easy manner while searching for relevant information. Adoption of chatbot applications in academic library reference services is growing in Western countries. McPherson (2013) and Woods (2018) argue that the AI chatbots will create a conducive environment for conversational interactions related to references. New undergraduate students will be more comfortable in searching for information and can avoid library anxiety during their research.

Academic library reference services are in their early phases. Most of the users are conversant with Apple's Siri, Cortana, Amazon's Alexa and Google assistant chatbots which are used in daily life. As explained by Mckie and Narayan (2019), artificial intelligence has been an innovation used largely by the information technology field. It has positively impacted academic library services and provided virtual reference services.

The current paper was designed as follows: First, is the overview of artificial intelligence in reference services. Second, is an analysis of the advantages provided by chatbots in reference services. Third, is a section addressing the user limitations of chatbots, followed finally by the literature review and the methodology. Afterwards the discussion was presented. The paper ends with the conclusion along with future direction for further research.

### **Overview of Artificial Intelligence Chatbots in Reference Services**

The Association for the Advancement of Artificial Intelligence (AAAI) defined artificial intelligence as, "The scientific understanding of the mechanisms underlying thought and intelligent behavior and their embodiment in machines". The intelligent behavior has been stored in machines as understood through the variety of definitions. In the foreseeable future, there will be human-like machine intelligence. Chatbots are generally defined as artificial entities which are capable of conversational interaction. They are also called conversational agents.

AI has the potential to play multiple roles in academic library functions. However, we attempt to focus on the usage of AI chatbots in reference to services where humans and computers will be collaborated. According to Rubin et al. (2010), the four main functions in libraries are served by human computer interactions: i.e. educational, informational, assistive and interactive. Chatbots are computer programs that simulate an intelligent conversation through text, speech or through an embodied representation. They are also referred to as digital assistants or virtual intelligent agents. They answer directional, reference and predictable inquiries. Chatbots are available 24/7 and are consistent in effective answering queries according to Gujral et al. (2019).

We cannot depend on chatbots in order to replicate or reflect human knowledge and emotional output. However, chatbots have the potential to deliver a cost-effective way to respond to most routine reference queries and guide users to the appropriate service point. The goal of digital reference assistants is not the replacement of humans or avoiding human interaction, but rather to enhance the routine services of reference desks and to increase the service output.

### **Chatbot Advantages in Reference Services**

Artificial intelligence chatbots will be beneficial in the following areas.

If routine reference queries are managed through chatbots, the reference desk staff will have more time to focus on the special research needs of the users and contribute more productively toward satisfying the information needs of the users. Meanwhile, if the chatbots are combined with human interaction it will be easier for librarians to solve complex information requests from users.

Chatbots facilitate for multiple users to benefit from the chat services simultaneously. Therefore, the users can receive prompt and continuous responses.

Chatbots are incapable of expressing emotional responses to silly and meaningless questions. As such, the users feel free and comfortable interacting with them.

Library resources and services can be marketed through chatbots eventually. Through this channel the users can become familiarized with library facilities and learn how to get good usage of the available resources.

In general, chatbots have potential to provide tailor-made notifications and alert messages to users so that the libraries can deliver selective dissemination of information (SDI) and alert services to their users.

Chatbots have potential for holding continuous conversations that facilitate the users engaged. The Facebook Messenger bot is a good example for this.

Chatbots can collect relevant information for the consequent conversation with the human representative. Through the information collected the chatbot can automatically learn clearly what was previously interacted, what the user needs and, potential solutions for basic queries.

Millennials can be attracted through chatbots that can develop strong relationships with them. This effort to attract the younger generation happen by shifting the method of accessing information via internet browser to chatbots on mobile devices.

Chatbots are available for 24/7 service. The users can access them very conveniently at anytime from anywhere, even while the library remains closed.

### **User limitations of Chatbots**

It is noted that the output of chatbots is fixed and limited so that it cannot respond to an input query which is not recorded in the knowledge base. A chatbot's ability depends on the associated knowledge base and language processing. The possibility of mistakes occurring is high due to irregularities that can be a primary obstacle for a multi-cultural environment.

A chatbot has limited conversational ability as it doesn't respond to multiple queries simultaneously. Due to the limited understanding capacity of chatbots, the users may feel uncomfortable dealing with machines to get the responses for their queries.

## **LITERATURE REVIEW**

Artificial Intelligence Chatbots have been adopted in many sectors related to customer relationships. A research team Liao et al. (2016) designed a knowledge enriched multimodal fashion chatbot that assists customers in searching for products and matching different styles. They discussed the system and presented their techniques and experiences while highlighting the challenges in the field. Ko & Lin (2018) have introduced a cardBot, a chatbot for business card recognition and management where an OCR module was applied. In the health sector, Madhu et al. (2017) proposed an idea for developing AI chatbots for medical treatments. This particular type of chatbot assists people in taking the necessary medication and treatment. Park and Jeong (2019) have introduced a new dialog chatbot that interacts with the customers nearby. As per their belief, it also has potential for other fields. Villegas-Ch et al. (2020) discussed the AI model chatbot responses to the needs of students within a smart campus.

Artificial Intelligence (AI) has the potential to transform the roles and functions of libraries in order to serve the new generation of library users. Gupta et al. (2020) articulated the application and potential impact of artificial intelligence in academic libraries. They identified four domains: educational, informative, assistive and social networking for artificial intelligence applications. According to them, the libraries can adopt AI for several purposes including reference services,

and highlighted that the final goal of the chatbots is streamlining the functions of the reference services unit (Vincze, 2017).

Mckie and Narayan (2019) in their exploratory paper emphasized the importance of engaging librarians in developing chatbots along with the collaboration of technology developers to satisfy the requirement of the conducive learning environment. Cox et al. (2019) explained that Artificial Intelligence was considered to be one of the prominent areas of focus that should receive attention from all sectors.

Tubachi and Tubachi (2017) pointed out that the basic information related to library services and facilities may be delivered through simple chat, extended chat or through video conferencing, email, FAQs, guided tours, asking a librarian, web forms and chatbots. The chatbots can play an effective role to reach the users 24/7. As they pointed out that virtual references are considered an important tool in libraries. Chatbot integration within a library website is easy and cost effective for libraries to expand their information services. Ali (2019) has shared the experiences of developing “proof of concept” and “AskSmooSmoo” chatbots and he pointed out three areas of concern: user experience, collaboration and talent management for effective services.

Allison (2012) expressed in his research paper that most of the queries of the users were directional or factual queries. McNeal and Newyear (2013) discussed that libraries can form their own bot using available coding options. AIML (Program Z or Program O) and Chat Script are considered the best options for this purpose. “Virtual Reference” is considered an important tool to enhance reference services. In order to enhance information services, chatbots can be integrated with websites in an easy and cost-effective manner.

After systematic examination of literature review, this study found that there was very small number of research works done in this direction, therefore the present research aimed to conduct the study to reduce the gap. Moreover, the authors discovered that there were very few studies had been taken in Bahrain context. So that, the researchers examined the benefits of AI chatbots in reference services of academic libraries in Bahrain.

## RESEARCH METHODOLOGY

The study examined previous literature to develop constructs for chatbots for reference services. In order to obtain appropriate literature, the study has used various methods to collect relevant data. The references used include: Web of science, Scopus, Elsevier, Emerald publishing, Science direct and LISA, to get meaningful information in the selected area of the topic.

Additional help was taken from Google, Google Scholar, Research Gate, Academia, Bing, Yahoo, Baidu, Yandex.ru, DuckDuckGo, Ask.com, AOL.com, Microsoft Academic, Base, Core, Science.gov and Semantic Scholar. Lastly, periodic and reviewed leading journals, which frequently publish articles on artificial intelligence and reference services were referenced in addition to various websites that focus on the topic of artificial intelligence and reference services in order to be comprehensive.

## FINDINGS AND DISCUSSION

After careful investigation on the literature review, authors found that, it is positively considered to think that this chatbot could provide with many potential positive improvements into

academic library reference services. However, most of these potentials are being tested, investigated and reviewed in its initial stages and here the authors developed a model that would enhance effectiveness in reference services in academic libraries, especially in Bahrain context.

### Simple Library Chatbot Model for Academic Libraries

This study has aimed to discuss chatbots in reference services. Therefore, the authors explored the study of chatbot reference services in three different entities in order to be created. The patron interface has the ability to receive and send texts through Natural Language Processing (NLP) which reads, converts, understands and forms entities and intents of the patron's query and the text's data is processed. The machine responds to the patron through using a knowledge base or database to accomplish the task for complex queries.

The diagram below describes the basic process in forming a simple Library Chatbot (Figure 1).

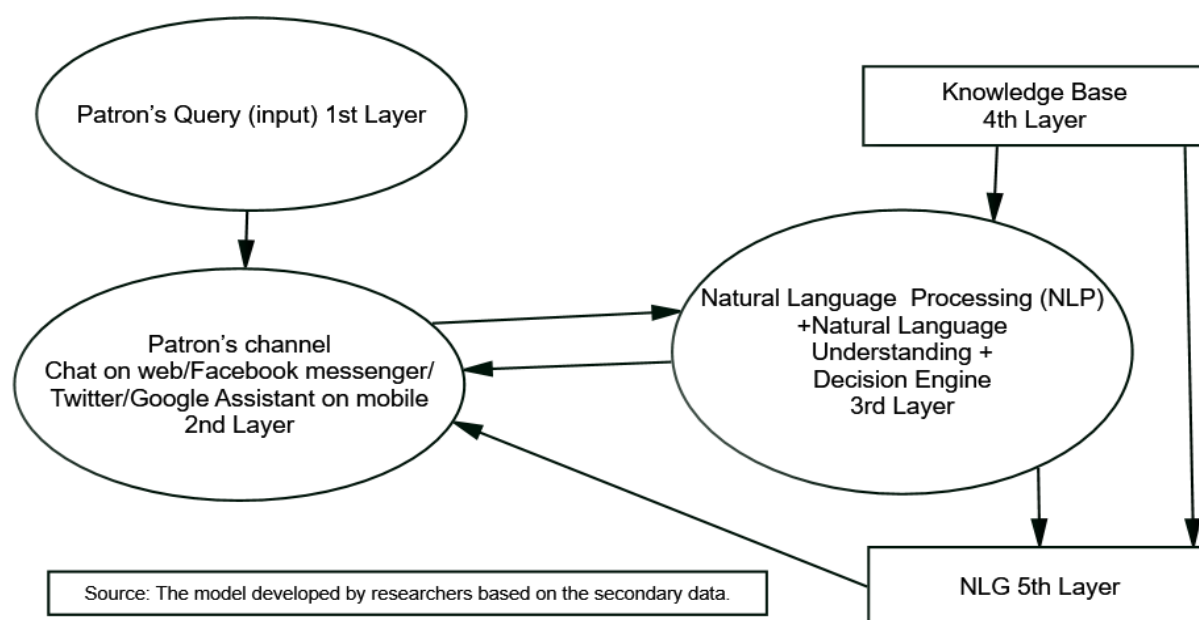


FIGURE 1

### BASIC PROCESS IN FORMING A SIMPLE LIBRARY CHATBOT

By examining of the result, the Figure 1 was developed and we found the 5 layer of process of AI chatbot, which is very useful in the reference services of academic libraries. The study explained about the layers, the first layer act as an Input, second as a Patron's channel, 3rd as a Natural Language Processing, 4th as a knowledge base and finally, Natural Language Generation and these concepts were discussed in detail in the discussion part.

We can decide the general framework before the process.

The Following matters are to be determined: PPS

- The problem that will be solved through bot

- The platform to deploy to the bot
- The server that runs the bot

The patron's input (1st Layer) initiates the patron's channel (2nd layer) which is represented by the displayed patron interface. The interface can in fact be installed in the library service contact point. The researchers found that telegram messaging app or Facebook messenger, which was popular among the patrons, can be deployed. This layer can receive and send text with the support of a 3rd layer which consists of three core units: Natural Language Processing (NLP), Natural Language Understanding (NLU) and Decision Engine (DE). These units provide artificial intelligence to the chatbot to send messages properly. The stages of NLP process will be from input to preprocessing results: sentence detection, co-resolution, tokenization, lemmatization, POS-tagging, dependency parsing, named entity recognition, semantic role labeling. The Natural Language process generates 'Intents', 'Actions' and 'Entities' from the inputs of patrons inputs. The Natural Language Understanding unit detects the intent of the patron and categorizes the input into a predefined intent. The Decision Engine understands the domain knowledge from the existing data and facilitates a decision.

The fourth layer is a knowledge base which is considered as the main unit of the AI chatbot. It needs a large amount of data to be trained in a systematic manner. The intelligence of the chatbot depends on the information quality of the knowledge base. A proper and systematic arrangement of the knowledge base assists the bot to learn quickly.

The fifth layer is Natural Language Generation (NLG) which converts abstract statements into a natural language surface output.

Gimlet is a reference tracking software; the recorded data can be utilized to develop the bot's knowledge base. Each query or input of the patron into the bot's knowledge base needs different types to connect permutation of the query and to find a relevant response or output.

The researchers further explored that more flexibility and quality analysis can be received from a chatbot developmental framework. Facebook Bot Engine, Google Dialog flow, Microsoft Bot, IBM Watson and Amazon Lex are leading chatbot development frameworks that facilitate for anyone to create their own bot.

## CONCLUSION

The reference services department of an academic library is vital in order to optimize the usage of library resources and facilities. Most of libraries implement text messaging and chatting in their reference services to enhance the output and facilitate the library patrons to access the reference desk conveniently. A chatbot is a similar tool that doesn't require face to face interaction; we cannot depend on chatbots exclusively for responding to the patrons' reference queries as they are not able to imitate human knowledge and feelings. However, the Bot can provide readymade responses or answers for the most frequently repeated reference queries and guide users towards the proper contact channels in order to get the appropriate service in a cost-effective manner. Libraries need to adopt new technology in order to enhance their services so that they can create well-balanced work practices between their human and digital librarians to further leverage the unique ability which each possesses.

Most of the libraries in Europe have become pioneers in adopting new technology to enhance their services, but the Middle East and North African libraries are slow in adopting it. The

library patrons are most familiar with these developments and expect library professionals to cater them through those channels. Therefore, the librarians are required to recognize and understand the technological changes and utilize them to provide opportunities to the contemporary and potential user communities.

A chatbot with customization and personalization is able to be more interactive and supportive, engaging the students with library reference services.

### **FUTURE DIRECTION FOR FURTHER RESEARCH**

This paper has highlighted some thoughts on the potential of AI chatbots in reference services in Bahraini academic libraries. A similar study can be conducted in other GCC countries, or other individual countries. Saudi Arabia, Kuwait, Oman, UAE & Qatar. Additionally, possible in Arab region. Moreover, there can be a study adding some features like integration with mobile devices in chatbots as this research has focused on text-based chatbots exclusively. A study on Robotics Automation Process (RPA) in reference services can be an interesting research topic within GCC countries and the Arab world.

The limitation of this research is that it was conducted in Bahrain based on available literature. The libraries in Bahrain are still not quite ready for chatbots due to various factors like budgetary issues, limited number of students and academic programs, expertise and patrons' preparedness.

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