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A Conversational Web-Based Chatbot to Disseminate COVID-19 Advisory Information

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Abstract. Chatbots are computer programs which integrate Artificial Intelligence (AI) and Natural Language Processing (NLP) technologies to simulate human conversation. The use of chatbots has significantly been increased during the COVID-19 pandemic to support healthcare procedures and systems. The purpose of this study is to present the design, implementation, and initial evaluation of a web-based conversational chatbot aiming at the immediate and reliable information regarding the COVID-19 disease. The implementation of the chatbot was built on IBM's Watson Assistant. The chatbot "Iris" that was created is highly developed with the ability to support dialogue, since it has a satisfactory understanding of the relevant subject matter. The system was pilot evaluated using the University of Ulster's Chatbot Usability Questionnaire (CUQ). The results confirmed its usability and that Chatbot "Iris" is a pleasant experience for users. Finally, the related study's limitations and future steps are discussed.

Keywords. COVID-19, Pandemic, Chatbots, Artificial Intelligence.

1. Introduction

The COVID-19 pandemic, with its rapid and uncontrolled spread, has put the entire humanity in a state of emergency. The constantly generated information on disease progression, effects and protection measures created an environment of uncertainty and increased the need for reliable and easily accessible information from the general population. In response to this pandemic, researchers, organizations, and companies have joined a race to create assistive technology applications by developing chatbots. Chatbots are computer programs or conversational agents which integrate Artificial Intelligence (AI) and Natural Language Processing (NLP) to "simulate conversation with a user through messaging applications, websites, mobile apps and more, giving them accurate and relevant information" [1] Chatbots have quickly become effective assistants in the unprecedented need for valid and up-to-date information by preventing misinformation. During the COVID-19 pandemic, they have been used to disseminate health information, assess personal risk, monitor exposure, symptoms and alerts, combat misinformation [2].

The purpose of the study is to describe the structure, design, implementation, and pilot evaluation of a chatbot, the chatbot "Iris", aiming to provide advice and disseminate

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useful and reliable information and knowledge to the general population about the COVID-19 in an interactive way.

2. Methods

Our prototype. web-based chatbot followed the process of the Software Development Life Cycle [3], with the phases: requirement analysis, design, implementation, testing and evaluation. In the requirements analysis phase, we determined the functionality that our chatbot would incorporate, through discussions with potential users, by reviewing the literature, and by studying and analyzing other chatbots. The web-based chatbot should: a) allow access without user identification requirements, b) accept questions from users in text form in the Greek language and also respond in text form in the same language; c) store the history of questions – answers; d) suggest alternative questions in case the user's question is not recognized or unclear; e) provide accurate, and useful answers and information drawn from authoritative sources, f) link to websites and additional reliable resources to obtain updated data and statistics about the COVID-19, e.g. number of cases, deaths by country, etc.

In the design phase the operating model of Chatbot “Iris” was based on “rules” and its flow architecture is the Pattern Matching Architecture [4]. We predefined the matching of 52 rule patterns with wording variations. In these conversation patterns, the more extensive the database of rules, the more efficiently and specifically the chatbot could respond. In addition, we designed dialogue nodes, each of which corresponds to a question with its corresponding answer or a set of answers (Figure 1). Each dialog node contains, at a minimum, a condition, and a response. In the implementation phase, we used IBM's open-source virtual agent 'Watson Assistant (WA)', which is a data analytics processor using NLP and AI, and integrated it into a WordPress Content Management System (CMS).

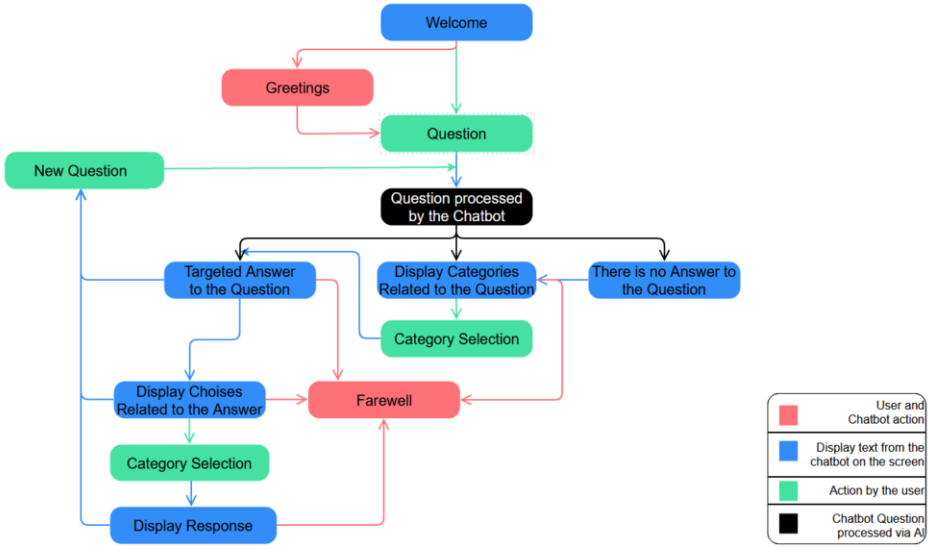

Figure 1. The system's architectural structure flow chart.

In the testing and pilot evaluation phase, the system was tested on random potential users, to check its functions and identify possible failures or shortcomings. A sample of

20 people was selected to be of different gender, age, and education. We used the University of Ulster's Chatbot Usability Questionnaire (CUQ), consisting of 16 questions [5], which measure the User Experience (UX) and usability of chatbots. The questionnaire was distributed to the users of Chatbot "Iris" through Google forms.

3. Results

Chatbot "Iris" is embedded in the lower right part of the website developed, welcoming the users, and asking: "how can I help?" (Figure 2A). The chatbot accepts any query or question from the user related to the COVID-19 and respond accordingly. For example, if the user types "what should I pay attention to in order to protect myself?" the chatbot informs the user about the preventive measures (Figure 2B). Questions that do not exist in the chatbot's database are answered with general answers or with the use of reliable links and sources. In case the user does not know exactly the question he wants to ask, Chatbot "Iris" guides him to the answer he is looking for by asking him to choose question topics or keywords (Figure 2C). The chatbot's trained data are 52 intents, 9 entities, and 48 dialog nodes; while the number of questions registered in the database is approximately 640. The data of questions typed by the chatbot users are not stored or further processed. Chatbot "Iris" is hosted is an informational website about the COVID-19, which includes reliable information and articles (e.g. infection from Sars-Cov2, symptoms, preventive measures). The URL of the Chatbot "Iris" and the hosting website is: https://covid19-chatbot.hil-nurs.gr/.

The pilot usability evaluation results were very positive, with a mean score of 92.2/100. In the question whether the chatbot's personality is realistic and attractive, 95% answered positively and in the question whether it failed to answer many questions, 85% answered negatively.

Figure 2. Screenshots of answers from the chatbot "Iris" (A, B, C).

4. Discussion and Conclusions

We presented the design, implementation, and initial evaluation of a prototype, web-based, conversational chatbot. Using the latest AI and NLP technologies, chatbot "Iris" is a highly developed virtual conversational assistant that aims to disseminate the most accurate and reliable advisory information about the COVID-19 to the general population. It supports dialogue and understands satisfactorily the topics related to the

COVID-19 pandemic in the Greek language. It does not only successfully produce written speech, but also understands any spelling or syntactical errors. The testing and pilot evaluation results indicate that "Iris" satisfies properties such as accessibility, security, consistency, speed, accuracy, friendliness, and liveliness, achieving a high usability score. It is hosted in an informational website about the COVID-19, and it could easily be incorporated into any informational website for the general population, on pandemic-related topics. Although chatbots to combat COVID-19 and disseminate health knowledge are taking their first steps, many similar prototypes have been implemented during the pandemic [2]. In an attempt to compare the "Iris" chatbot with an equivalent, we compared it with "Theano", a Greek-speaking conversational agent for COVID-19, developed at the Athena Research Center [6]. We tested the same questions in both chatbots and noticed that in questions about statistics including "deaths, cases" we received similar answers. On the contrary, in questions that were more general or did not exist in the chatbot's database, "Iris" responded by providing suggestion topics or keywords for the user to select, while "Theano" could not respond. For example, in the question "how many are the intubated in Greece today?", "Iris" responded with a six-choice suggestion, while "Theano" did not recognize the question and gave no response. During the implementation of the chatbot there were limitations such as the use of free basic versions of IBM's "Watson Assistant (WA)" platform, and the restricted number of rules and questions registered in the chatbot's database, which could limit the performance capabilities of the chatbot. Furthermore, the evaluation results cannot be generalized, since we conducted a pilot evaluation with a small sample size.

Regarding the future steps to our research, increasing the database rules and questions would be one of them, since "Iris" belongs to the simple "rule-based" operating model, with a closed discussion topic and uses free basic implementation tools. This step would increase the accuracy, reliability, and sense of "human intelligence", during the conversation with the user. Conducting the evaluation on a larger sample, would be another step that would possibly confirm the positive results of the pilot evaluation. Similar conversational agents have achieved positive or mixed evaluation results concerning the effectiveness, usability, and satisfactoriness [7]. It seems that health chatbots are here to stay. Their spread is very fast, and their possibilities are many. We could predict that in a few years the technologies that support chatbots will be further improved, and the virtual agents will offer equivalent services, at least in terms of disseminating advisory information and knowledge, as well as trained human agents.

References

[1] How to Build a Chatbot - IBM Watson Assistant - Docs resources [Internet]. 2021 [cited 2021 Sep 17]. Available from: https://www.ibm.com/cloud/watson-assistant/docs-resources

[2] Almalki M, Azeez F. Health chatbots for fighting COVID-19: A scoping review. Acta Inform Med 2020;28(4):241-247, doi: 10.5455/AIM.2020.28.241-247.

[3] Barker TT. Documentation for Software and IS Development. In: Encyclopedia of Information Systems, Volume 1. 1st ed. Elsevier Science; 2003. p. 683–93, doi: 10.1016/B0-12-227240-4/00047-2.

[4] Ramesh K, Ravishankaran S, Joshi A, Chandrasekaran K. A Survey of Design Techniques for Conversational Agents. CCIS 2017;750:336-350, doi: 10.1007/978-981-10-6544-6_31.

[5] The Chatbot Usability Questionnaire (CUQ) [Internet]. [cited 2021 Sep 27]. Available from: https://www.ulster.ac.uk/research/topic/computer-science/artificial-intelligence/projects/cuq

[6] Theano: A Greek-speaking Conversational Agent for COVID-19 | Athena Research Center [Internet]. [cited 2022 Jun 9]. Available from: https://www.athenarc.gr/el/theano-covid19-chatbot

[7] Milne-Ives M, de Cock C, Lim E, et al. The Effectiveness of Artificial Intelligence Conversational Agents in Health Care: Systematic Review. J Med Internet Res 2020;22(10), doi: 10.2196/20346.