Medical Chatbot for Novel COVID-19

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Abstract  Conversational agents or more universally known as the chatbot were industrialized to respond to user’s queries in a particular domain. Chatbot would serve as a software delegate which enables a computer to converse with human via natural language. A chatbot is a human-like conversational character (Shaikh et al. Int J Eng Sci Comput 6:3117–3119, 2016 [1]. This technology was coined in 1960s, with the intention to impersonate a human (how he would reply to a particular situation) so that the user feels that he is talking to a real person and not a machine. Conversational agent that interacts with user’s turn by turn using natural language (Shawar A, Atwell E (2005) ICAME J Int Comput Arch Mod Med English J 29, 5–24, 2005 [2]). The world of chatbot has seen much of the advance since the invention, and they have progressed from conventional rule-based chatbot to unorthodox AI-based chatbot. The chat agents are expert in their fields [3]. The prime focus of this paper is to show implementation of a retrieval-based chatbot with voice support, and we will investigate other standing chatbot and how it is useful in helping the patients fetching all the necessary details about COVID-19.

Keywords  Natural language processing · Retrieval · ELIZA · Simulation · Set of responses

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1 Introduction

The world has seen a drastic change in technology; the facilities today have completely altered. There was a time when people did not rely on technology for everything. Because of this change, there is a need for the use of conversational agents. Chatbot changes the way of providing the services. Instead of using Web sites or installing another new applications, users could simply order a service via a chat interface [4]. Lately, the world has suffered from a calamity, which has caused vast wreckage, namely COVID-19. The fatality rate is saddening. Facts suggest that people are not really aware about the causes and symptoms of COVID-19. There already exist conversational agents that reply to people’s queries on countless infections but no work or fewer work is done on chatbot for COVID-19; therefore, our enthusiasm behind this work is to create a chatbot that would answer all the basic enquiries and the quandaries faced by anybody who seeks help from this chatbot and give as much as possible to make people avail all the necessary help they need. It would answer queries like “Is traveling safe?”, “what could be the possible symptoms of COVID-19,” etc. Also, mostly chatbot is text-based, and this chatbot completely works on voice support.

2 Existing Systems

Chatbots can be categorized on the basis of their input processing and method of output generation as:

2.1 Rule-Based

Rule-based chatbots are trained on a given set of defined rules to generate suitable responses for user’s queries. When the number of possible outcomes is fixed and scenarios are imaginable in number [5], such chatbots are very useful. Rule-based chatbots prevent nonsense responses, grammatical errors and spelling mistakes which can reduce user experience. If the chatbot is made with help of an expert of the subject on which the chatbot is created, it will be more accurate and reliable. As under the expert’s guidance, a chatbot can reach its goal better and efficiently. For businesses that deal with straight questions that do not require much intelligence and customized answers [6], such chatbots are usually preferred. Two popular examples of chatbots using rule-based approach are:

ELIZA. Joseph Weizenbaum created ELIZA, which gives a computer the ability to have a natural language conversation with a human being. ELIZA program was made to simulate a psychiatrist’s discussion with patients [7]. When the user is conversing with ELIZA, the user will type a normal statement. ELIZA will then
give a typed response according to the statement written by the user after analyzing it. Control is then again with the user [8]. Weizenbaum’s famous simulation of a psychotherapist [9] gave inspiration for the creation of many chatbots in the world.

**Parry.** Psychiatrist Kenneth Colby created PARRY, an example of early chatbot created after ELIZA was made. PARRY was developed to simulate a paranoid patient [10]. Colby considered PARRY as a tool for studying the paranoia’s nature and ELIZA as a clinical agent that can hourly manage hundreds of patients. It has also been claimed that PARRY, a simulation of paranoid thinking [11], had passed something that could rightfully be called a legitimate Turing test [7] that ELIZA could not.

Also, our proposed system uses this approach for greetings. The rule-based approach has its benefits, but it is also limited by the set of rules. It lacks intelligence and users might have questions that it is not trained for. Due to this reason and to make chatbots human-like, people started using machine learning to make chatbots.

### 2.2 Self-learning-Based

Chatbots following this approach use machine learning and artificial intelligence technologies for learning from their previous conversations for chatting. Self-learning chatbots are useful when users have different types of queries that are not restricted by rules. Chatbots following self-learning approach can be further categorized as:

**Retrieval-Based.** A retrieval-based chatbot ranks data and selects responses instead of a new one. The output will be the best ranked from the set of responses that are already defined and finite. The chatbot is trained to do so and is successful most of the time. Retrieval-based bots are the most common type of chatbots that are created. Such an approach is probably the best option for bots that have a goal. Our proposed system majorly uses this type of self-learning for the goal of making people aware of COVID-19 (Fig. 1).

**Generation-Based.** A generation-based chatbot generates responses instead of selecting them from the underlying model [12]. Chatbot using this model is trained with a vast set of early conversations instead of predefined responses which may not always be available. Such a chatbot has a response for any query, but it may not always make sense and might have grammatical and spelling errors due to which it needs more research (Fig. 2).

With a detailed comparison between retrieval-based and generation-based as shown below, we can see why our proposed system is retrieval-based.

### 3 Generation-Based Versus Retrieval-Based

Generative bots are used widely, but retrieval-based bots provide more enhanced speech processing and extracting measures, thereby helping in generation of almost accurate results and learned responses. They learn from the set of responses stored
and try to develop a learning behavior based on the previous stored quoted responses. This increases the fluency, accuracy and diversified nature of the output. Response suggestion is an important for building computer–human-aided conversation systems [13].

Neural architecture had been used in the previous studies which improvised the nature of responses generated. Multi-contexture encoding was pulled over single text encoding enhancing the performance up to significant level. The majority deployed chatbots are complete retrieval model and have some limitations for the facts too. These bots already have proper answer and require no manipulation, framed with almost no grammatical errors. But, in some cases, these bots fail to generate those responses even properly framed question by the user. Retrieval is based on database stored in the machine, and if the database is efficiently arranged using suitable and emphasized algorithms, then some queries can be solved more accurately.
They are incapable to refer to contextual entity datasets like names mentioned previously in the conversation. While, secondly, they lean on programmed framed repository of predefined responses [14], they do not exhibit grammatical mistakes, because they pick from the user responses and offer a satisfied user experience who interacts with these bots.

While, in the generative-based bots, the answer and the response are struck between growing and learning states which means that there is more work yet to be done to make these family of bots more better reliable entity and generate almost user-friendly, self-learnt responses. In generative bots, the conversation looks just like real-life conversation between humans. Generative bots need to be upgraded every time with new AI methods to generate a powerful tool in the respective field usage.

The limitation set of generative type involves training and testing of large data sets which makes it cumbersome approach; that is why, mainly, all the bots are based on the retrieval-based approach. Currently, the main application of these bots is solely in field of e-commerce, education and real-time mobile-based applications.

In modern growing world of today, various sites and methods are available that provide users with no prior knowledge to build and develop their very own friendly bots. Those bots would be comprised of online developer modules which can be interim connected via Internet services by defining handful of parameters; that is why, retrieval-based bots are considerate in these scenarios. In our developed application on “COVID-19”, the collective efficient dataset is more viable to retrieval process because it mainly focuses on highlighting the quick response and providing the necessary information to the user even unknown of its deadly affects, whereas generative approach will not be as effective in this case.

But using the learning and the principles of deep learning, both methods can be modified for purpose-based requirement in the future.

4 Proposed System

In this paper, we highlight the speech-based as well as a text-based medical chatbot. The recent outbreak of COVID-19 brings light to the fact that a majority of the populous in oblivious of the information required to deal with it. The chatbot is designed to address the frequently answered queries like: “How can I protect myself from coronavirus?”, “What is coronavirus?”, “Symptoms of coronavirus” and many more. So, this chatbot will not only solve these queries but also give you some important news regarding the coronavirus. Not only will it make people aware of the basic information about COVID-19 but also help to reduce the chances of being infected. This system is based on natural language processing, speech recognition systems and machine learning (Fig. 3).
5 Implementation

This chatbot is based on two types of learning algorithms: self-learning and rule-based learning. This system takes input in the form of speech using a microphone from the user. After taking a voice signal as an input, the system starts processing the voice signal and converts it into text data. Speech analysis can be broken down into given stages:

(i) Voice signal recognition and convert the signal into text
(ii) Text processing
(iii) Convert text into voice signal as a response.

Firstly, the user passes their query through a microphone. This system extracts features from the input signal. Specific instructions can be used to read the input signal and then to convert it into text. [15] Now, the given text is handled using natural language processing. In this, it carries out different natural language processing methods to sort out the required text by using various techniques like shallow parsing, deep parsing, semantic role labeling, conference relations and named-entity recognition. [16] Deep parsing technique is a technique in which the chatbot takes an input statement from the user and performs tokenization and segmentation [6]. The text input is split using word tokenizer to extract the keyword and eliminate stop word. Using cosine similarity() method, system measures similarity score and tries to find an answer from the dataset which is more similar to the user’s query. Finally, chatbot
can be able to give an accurate, short and concise quick response to the user. The conversation between the user and the system can be done by both typing text and using voice. In the last step, it converts response text into a verbal response. Now, the text is analyzed before passing it to the linguistic model and converted into spoken words.

6 Conclusion

COVID-19 is a deadly virus which has taken world by storm. COVID-19 devastated USA, Spain, Italy, Germany and various other nations across the globe originating from Wuhan, China. Most people start to feel frequent fever, coughing, illness and sneezing. It is more fatal for old people and to those who have diabetes, asthma or any other kind of respiratory syndrome.

People are unaware of various measures of its prevention. Its cure is still in search, a kind of global health emergency, and awareness campaign is born like never before.

This project focuses on this serious concern, using knowledge on the bots created before, and it is just an attempt to provide a simple and yet powerful voice-based bot. It is based on the concept of machine learning combined with the real-world entity to highlight and aware people about the prevention and seriousness of this deadly virus.

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