Pharmabot: A Pediatric Generic Medicine Consultant Chatbot

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***Abstract*—The paper introduces a Pharmabot: A Pediatric Generic Medicine Consultant Chatbot. It is a conversational chatbot that is designed to prescribe, suggest and give information on generic medicines for children. The study introduces a computer application that act as a medicine consultant for the patients or parents who are confused with the generic medicines. The researchers use Left and Right Parsing Algorithm in their study to come up with the desired result.**

***Index Terms*—generic medicine, medicine consultant, pediatric consultation, chatbot, natural language processing**

I. Introduction

Nowadays, the interest about enhancing the interface usability of applications and entertainment platforms has increased in the last years. Human machine as a technology integrates different areas, and the computational methodologies facilitate communication between users and computers using natural language.

Ref. [1] "A related term to machine conversation is the chatbot, a conversational agent that interacts with users, turn by turn using natural language. Different chatbots or human-computer dialogue systems have been developed using text communication starting from ELIZA that simulates a psychotherapist, and then PARRY which simulates a paranoid patient."

Ref. [2] "Eliza is the well-known artificial therapist. The bot tries to rephrase the questions of the client and reacts on certain keywords. If no keyword is found, Eliza replies with fixed phrases to keep the conversation going."

Ref. [3] "With the improvement of data-mining and machine-learning techniques, better decision-making capabilities, availability of corpora, robust linguistic annotations/processing tools standards like XML and its applications, chatbots have become more practical, with many commercial applications." Ref. [4] "Medicine is a field in which such help is critically needed." And in the recent times, robots and other forms of artificial intelligence are used in some sorts of medical applications.

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Ref. [5] "Chatbot Erica is developed for a dental practice in Netherlands. This online assistant is used to answer frequently asked questions of patients and visitors on the website. Among others, Erica has the important task to answer questions about free dental billing rates." Furthermore, Ref. [6] "Virtual Companion acts as a personal healthcare assistant and consists of an automated avatar with an embedded chatbot and other technologies to provide the requested information needed by the user."

These days, different technologies can be utilized to have a convenient and accessible health services to all. An example is the Ref. [7] "Telephone Consultation which uses telephone that offers not only time-efficiency and cost-saving benefits but also the open-ended availability and the risk of fuelling demand." Likewise, Ref. [8] "Online Doctor/ Medical Consultation overcomes geographic obstacles as well as gives the professional understanding for the patient with their concern, with no need to hold back for any medical expert, journey or even losing business days."

There are some existing applications that serve as medical consultants but none of them focus on generic medicines specifically for children and includes chatbot as a tool for conversation with the user. Therefore, the researchers developed a medicine consultant chatbot, known as Pharmabot that will act as consultant pharmacist that will give the rational, appropriate and safe medication of generic drugs for children based on the information collected from the user by chatting.

II. The Developed System

The system is developed using Visual C# as its front-end and MS Access as its back-end. It is intended to run on a stand-alone computer and it is not web-based system.

Fig. 1 depicts the Pharmabot's System Architecture

The system will display the main menu which consists of four buttons namely: Start, Instruction, Guidelines and Exit (see Fig. 2).If the user opted to click the instruction button the system will display the procedures on how to access the entire program. Consequently, if he clicked the Guidelines button it will display the rules on input/question format. However, if the user wants to start immediately the consultation using the chatbot, he should click the Start button.

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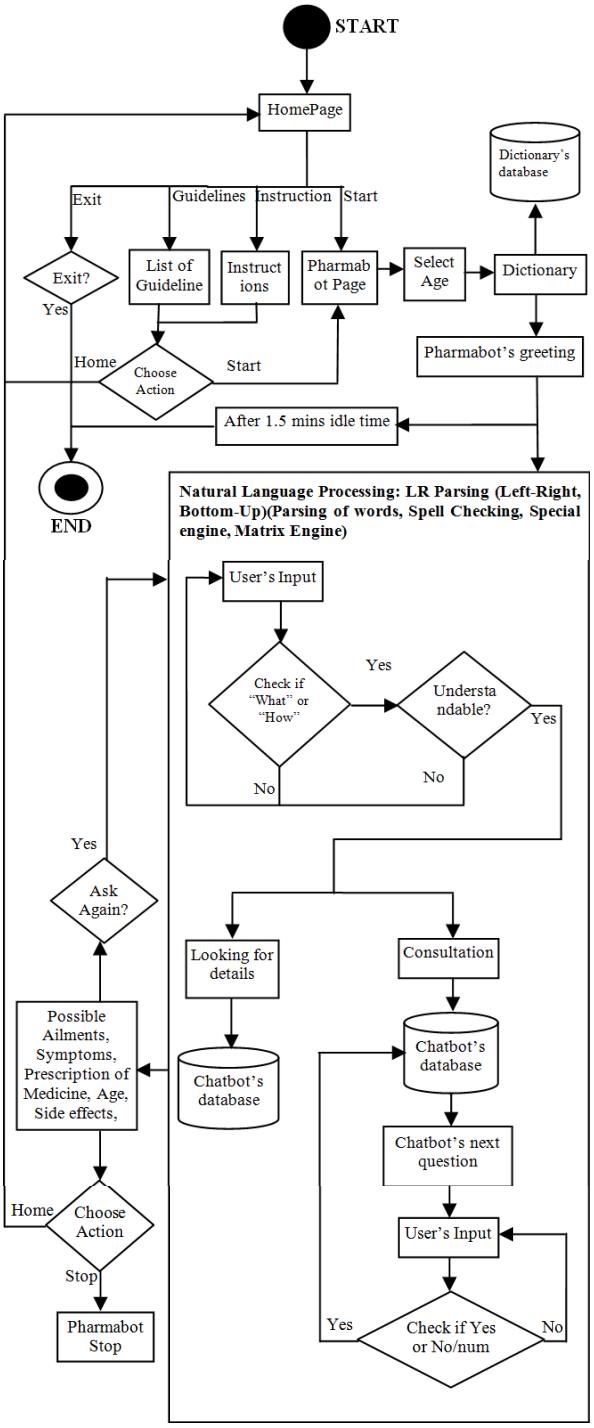

Figure 1. Pharmabot's System Architecture

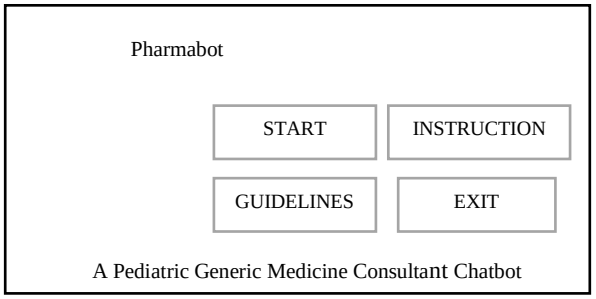

Figure 2. Main Menu

In the chatbot page (shown in Fig. 3), the user should input the age of the patient. The valid user's inputs should start with "How" or "What", or may include Arabic numeral/s and "yes" or "no" statement. If the user's input is invalid, the system will display an error message and prompted the user to input another question that is acceptable by the system. Those accepted user's inputs will be analyzed using Left-Right Parsing Algorithm (Bottom-Up and Left-Right approach) Ref. [9] "word per word in the Chatbot's database." One of the system's features is the provision of the dictionary database that provides technical and medical terms for a novice user. After series of conversation and consultation, the chatbot will prescribe generic medicines including proper intake, dosage, drug reaction, precaution and indication of medicines.

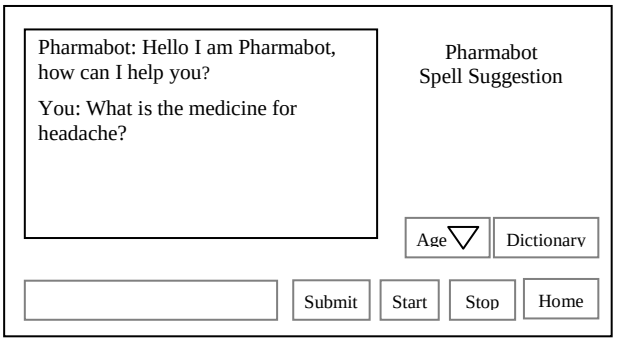

Figure 3. Conversation window

A. Research, Methods and Techniques

The researchers used descriptive method in the study. After the system prototype was developed, it was evaluated by the two groups of respondents: (a) experts-pediatricians and (b) students-pharmacy students. For the expert group, purposive sampling technique was used while for the students, random sampling technique was used.

Table I shows the groups of Pharmabot's respondents who evaluated the proposed system.

TABLE I. GROUPS OF PHARMABOT'S RESPONDENTS

Respondents	Total Size	Sample Size
Pharmacy students	28	14
Pediatricians	8	4

The first group consists of Pharmacist students from Our Lady Fatima University and the second group consists of the Pediatricians from St. Vincent Hospital. The Pharmacist students have the total population of 28 while the Pediatricians have a total population of 8 (see Table I). Thus, we got the 50% of the total population for both of them to answer the questionnaire.

III. RESULTS AND DISCUSSION

One of the objectives of the system is to develop a software application that will assist the user in taking the right generic medicine for a certain ailment. To test its

efficacy it was evaluated through a survey questionnaire. However, to prove the hypothesis that there is no significant difference between the assessment of the two groups of respondents regarding the developed system the authors used T-test.

Table II shows the comparison between the assessments of the student respondents and experts on Pharmabot, including the computed mean for students and experts.

TABLE II. COMPARISON ON THE ASSESSMENT OF THE STUDENTS AND EXPERTS ON PHARMABOT

Variables Tested	Students (X_1)	Experts (X_2)	df	Computed T-Test	Decision
User-friendliness	4.595	4.166	6	2.1923	2.1923 < 2.447 $T_{com} < T_{val}$ Accept H_0
Appropriateness	4.0	3.5			
Consistency	4.428	4.0			
Speed	4.5	4.1			
Mean	4.381	3.942			

The survey questionnaire is grouped into four (4) sections such as user-friendliness, appropriateness, consistency and speed of response. For the statements on the user-friendliness, the students have 4.595 weighted mean while experts respondents have 4.166 weighted mean. For the statements on the appropriateness, the students have 4.0 weighted mean while experts have 3.5 weighted mean. For the statements on the consistency, the students have 4.428 weighted mean while experts have 4.0 weighted mean. For the statements on the speed of response, the students have 4.5 weighted mean while experts have 4.1 weighted mean. The user-friendliness category obtains the highest Average Weighted Mean (AWS) for both group of respondents with AWS of 4.595 with a verbal interpretation of Strongly Agree for students and AWS of 4.166 with a verbal interpretation of Agree for experts. The appropriateness of answer category obtains the lowest AWS for both group of respondents with AWS of 4.0 for students and AWS of 3.5 for experts with verbal interpretation of both Agree.

Using T-test for uncorrelated data, the result, which is 2.1923, is less than the table value of 2.447 with 0.05 level of significance for two-tailed test and 6 as degrees of freedom. Calculated *t*-value is less than the critical *t*-value, therefore the decision is to accept the null hypothesis because there is no significant difference between the two respondents regarding their assessment to the developed system.

IV. CONCLUSION

Based from the acquired results of the study entitled "Pharmabot: A Pediatric Generic Medicine Consultant Chatbot", the researchers have come-up with the following conclusions:

- The acceptability of Pharmabot: A Pediatric Generic Medicine Consultant Chatbot based on the assessment of 4th year students of the College of Pharmacy of Our Lady of Fatima University in terms of its user-friendliness and consistency of response are both "STRONGLY AGREE". While the appropriateness of answer and speed of response are both "AGREE".
- The acceptability of Pharmabot: A Pediatric Generic Medicine Consultant Chatbot based on the assessment of the Experts from St. Vincent Hospital in terms of its user-friendliness, appropriateness of answer, speed of response and consistency of response are all "AGREE".
- According to the data gathered, analyzed and computed, the researchers showed that there is no significant difference between the assessment of the student and experts on Pharmabot: A Pediatric Generic Medicine Consultant Chatbot thus accepting the null hypothesis. Both respondents had different opinion and perception concerning the different variables tested.

V. CONCLUSION AND FUTURE WORKS

After conducting the study and throughout the gathering of data from the students and experts, the developed system can be used by the parent of the patients who need medical assistance in taking the right generic medicine for certain ailment.

In the future, the researchers will extend the study on increasing the number of diseases or ailments that the chatbot can process. In addition, it will provide more functions, can accept and understand new formatted questions and statements. Moreover, the system can also be converted into a web-based application so that everyone can access and use it.

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