A Comparative Study of Medical Chatbots

Jitendra Chaudhary[1],Vaibhav Joshi[2],Atharv Khare[3],Rahul Gawali[4],Asmita Manna[5]

[1,2,3,4]Student, Dept. of Computer Engineering, Pimpri Chinchwad College of Engineering, Maharashtra, India

[5] Asst. Professor, Dept. of Computer Engineering, Pimpri Chinchwad College of Engineering, Maharashtra, India

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Abstract - *In this era of digitization, chatbots are slowly becoming the first point of contact for customers with almost all business organizations, especially for real estate sector, education sector and medical sector. Chatbots in the medical sector are expected to replace the human operators for appointment set up, patient management, sending reminders and perform the operation of a medical assistant. However, the available medical chatbots are not yet able to perform all the duties of a compounder. In this paper, a comparison of various available medical chatbots along with their pros and cons is presented. A multilingual chatbot called 'HEALTHBOT' is also proposed. This chatbot will interact with patients in English and Marathi, will note down their symptoms and pathological test reports, prescribe the patients with further medical tests and suggest them basic medications, diets, and lifestyle changes. The prescriptions produced by the chatbot will be checked by the respective medical practitioner for further investigation. In short, this HEALTHBOT would be highly useful for the medical practitioners as personal assistant and not only that it would save valuable time for both the parties and reduce the medical treatment gap.*

Key Words: Medical Chatbot, NLP, Bots

1. INTRODUCTION

As more and more industries are moving towards complete digitization of their business processes, it is quite common that human point of contacts is being replaced by automated chatbots at least for regular, repetitive routine work. Chatbots are software or applications which help the user by providing the relevant answer to their specific queries. One can interact with the chatbot like they interact with other human beings. With the use of the chatbot in the health sector, the time of medical practitioners can be saved to a great extent. For implementing a chatbot, Human-computer interaction (HCI) technologies are used, and it allows communication between users and computers using natural language. The bot will use Natural Language Processing (NLP) to understand the user and will reply to them in a manner that will be easier to understand. From the current scenario, it can very well be predicted that at least 80% of the front-office jobs will be replaced by chatbots in near future.

While talking about the medical sector, it is often observed that people ignore their minor health issues or do not really want to visit a doctor. On the other hand, people spend a significant amount of time in browsing their smart phones. Human beings also have reservation about being in a fully automatic or machine-oriented environment. Human beings love interacting with another human about their issues. Chatbots can very well create an environment where people would not be judged but would get solutions to their problems based upon insights. Bots should provide a positive environment too for patients such that they don't get demotivated.

As the chatbots have improved a lot since the past few years, many enterprises started using bots for their customer care services. Medical bots are supposed to provide guidelines for the proper diet, lifestyle changes, and further pathological tests based on patients' symptoms of the disease. With the help of artificial intelligence bots would be able to prescribe proper medication as well, which can be further approved by the medical practitioner. In this paper, a comparison of available medical chatbots is presented. The pros and cons of all these chatbots are also identified. Based upon the shortcomings of the available bots, a new medical chatbot HEALTHBOT is proposed too.

Rest of the paper is organized in following manner. Section 2 displays the comparison of various available chatbots. It also specifies the pros and cons of those chatbots and identifies what needs to be improved for making the chatbots more user-friendly and accurate. Moreover it presents the outline of our proposed chatbot HEALTHBOT. Finally, section 4 concludes the paper.

2. Literature survey

2.1. A medical Chatbot[5]

This system is designed to help user to submit their complaints and queries regarding the health. It is designed in such a way that the user can have conversation with the chatbot in the form of text or voice. It makes use of Google API for conversion of text to voice and vice versa. It answers all the related queries to medicine and it's dosage. It predicates disease depending upon the symptoms using SVM (Support Vector Machine) algorithm. SVM is a dynamic classifier which is used to differentiate two classes. SVM classifies the test image in to the class having highest distance up to the neighboring point in the training. It uses NLP to have conversations with the user

and understand the meaning of the text. Porter stemming algorithm is also used for processing the text. It is a process of eliminating the ordinary words which is related to the exact form of words.

2.2. MamaBot: a System based on ML and NLP for supporting Women and Families during Pregnancy[6]

Using ML and NLP the system is dployed to support women during pregnancy. This chatbot is designed to help and support pregnant women, mothers with young children ,providing them rapid and useful suggestions in case of emergencies (e.g. "where is the nearest medical center") and also answers to their needs and references concerning disease prevention pathways, guidance on most proper lifestyles. It is designed to help pregnant women, mothers and families by providing different information (starting from a general level up to specific pathway questions) and giving a first-level support interaction to them as if it were a human being, in a chat-like conversation model. It uses Microsoft Bot Framework and LUIS (Language Understanding Intelligent Service) as cognitive service. LUIS allows the development of new models and creates HTTP endpoints that can be pinged to return simple JavaScript Object Notation (JSON).

2.3.Implementation of a ChatBot System using AI and NLP[7]

This bot is designed for providing college related enquiry to the user through text. This system is capable of giving all the answers of the queries relating to fields such as examination cell, notice board, attendance, placement cell and other miscellaneous fields. The major features of the chatbot are that it can answer college admission related queries. It provides help viewing user profiles and retrieves attendance and grade/ pointers. College students can fetch particulars about placement activities by using this system. It uses AIML (Artificial Intelligence Modelling Language) for giving response to the user. IT uses NLP to the modified input to check its similarity with the questions of a predefined question-set, whose answers are available. Lemmatization and POS tagging is also used for extracting keywords from given user input.

2.4.Developing Disease Classification System based on Keyword Extraction and Supervised Learning

In this paper they have focused on the EBM evidence based medicine which is originally used to describe the approach to teaching the practice of medicine and improving the decisions by a particular physician towards the particular patient. This has been using NLP natural language processing for efficient use of EBM. Further this paper has given two straightforward methods or steps in the methodology of implementation of the system. First step includes the proper extraction of keywords from the sentences which can be detailed symptoms from the users and then they use the all possible various techniques of Natural Language Processing like vectorisation,indexing of the keywords. Second step of implementation includes specific learning

of those keywords by artificial intelligence and getting classified according to the symptoms with diseases. These two steps have been used in this paper to do implementation of the system.

2.6.Disease Prediction using Machine Learning[3]

In this paper, it gives their work on applications of machine learning in the healthcare industry. The prediction of the disease with the help of the symptoms. In this of the applications they have used the decision tree classification algorithm as a prediction model as it has better accuracy as compared to the other models. In this study of disease prediction systems they have used Anaconda to perform disease prediction on our training and testing data-set from Kaggle, the data-set consists of 132 symptoms and based on the symptoms we have 41 types of diseases to predict. As early and accurate diagnosis can help to identify the disease on time so that best treatment can be provided to the patients. So here they are using a decision tree algorithm to get the accurate results. This paper represents the methodology for implementing disease prediction using symptoms with the technology of chatbot for the betterment of the health-care industry using the recent methodology. As early and accurate diagnosis can help to identify the disease on time so that best treatment can be provided to the patients.

2.7.A Self Diagnosis Medical Chatbot using Artificial Intelligence [1]

Chatbot are the specific type of computer programs which can be useful to establish the proper conversation between the users and the system. This paper gives the basic model of chatbot which is specific intelligence in specific areas to accept the input from the user and gives output accordingly to the user. Basically, this paper system gives provision to the users who can ask their health issues to the system and get proper output from it or we can say proper suggestions to the user regarding their symptoms. If the system will identify the major health issue from the symptoms entered by the users then the system will suggest to meet with a doctor to solve the health problem. System has three components including user validation, extraction of symptoms from the user, mapping of these symptoms with the datasets of symptoms and diseases which we have in the system. At last if the system finds out minor disease it gives suggestions and finds out major diseases, it gives suggestions to visit the hospital for proper treatment of users.

2.8. Pribots: Conversational privacy with chatbots.[8]

The sensitive health information of an individual can be at stake if the privacy policies are not transparent..The individual needs to be aware of every policy of the system he/she approaches.Traditional mechanisms for delivering

notice and enabling choice have so far failed to protect users' privacy.Pribot is a bot which deals with the privacy policies of the user. Pribots are a step forward in communicating the privacy policies.A pribot will be another bot dedicated to deliver privacy policies between patient and organization.The pribot provides an alternative to traditional notice delivery system,providing more natural touch and ultimately impacting the communication with the user.Pribot grants the control of the privacy policies to the user.A user can specifically change privacy policies according to his/her will.This level of transparency will ensure trust in the chatbot,and eventually increasing the usage of the system.

2.9.Trust in health chatbots[4]

Chatbots are highly vulnerable to malicious acts.Until this time the chatbots are always in a bad image,due to their vulnerability towards attacks,data theft etc.Due to this the people have lost their trust in chatbots.Implementing the chatbot in a field of sensitive information such as health parameters of huge number of people must assure the security of their data.People wouldn't like sharing this type of information with any other.And if by any chance the data is infected,or it is at stake the people would lose trust in the chatbot,leading to gradual lowering use of chatbot,ultimately sending the entire system to a halt.So the trust on the Healtbot must be gained and preserved.

3. Comparative analysis

The comparative studies of chatbots discussed above, are presented in table 1.

Table -1: Comparison of different medical chatbots

Survey Papers	Techniques	Functionality	Mathematical Model	Result	Conclusion	Advantages	Disadvantages
A Self Diagnosis Medical Chatbot using Artificial Intelligence [1]	It gives Linear Design that contains Artificial Intelligence, Pattern matching, Disease, Query processing techniques. It gives chatbot dialogue`s finite state graph and functional architecture	Identifies the corresponding symptom and minor or major disease and gives advice according to that.	Not Given	provides personalized diagnoses based on symptoms.	It is concluded that the system is user friendly and it can be used by who knows how to type in their language.	It is user friendly and the implementation of chatbot can provide better treatment in a short amount of time.	Chatbot identifies only minor and major diseases and gives permission whether to go to a doctor or not.
Disease Prognosis with Symptoms Endorsement using Combinational Classifier[2]	It gives a model for disease prediction from symptoms clustering and combinational classification by using various algorithms like K-Nearest Neighbor, Decision Tree, Naive Bayes.	It uses association rules for symptoms selection, identifies symptoms and predicts the disease well.	Given with decision tree algorithm and Bayes Theorem	Better than the rule based systems and accuracy of predictions can be ameliorated due to combinational classifiers.	It is concluded that on successful implementation, the system will be able to predict the disease effectively to achieve better results.	It is far better than a rule based system by increasing accuracy of identifying diseases by combinational classifiers.	If the number of symptoms will be less given then accuracy of identifying diseases may degrade.
Disease Prediction using Machine	It gives a flowchart of disease prediction followed by datasets, feature selection, data	On the basis of the dataset of the	Not given	Easy to access that establishes real time	It is concluded that this system is an interactive and user-friendly	Decision tree algorithms are used for better	Any new symptoms given by a patient

Learning[3]	preprocessing, decision tree classification, text processing, keyword matching.	symptoms, the system predicts the disease accurately.		communication using modern and updated technologies.	environment to predict a patient's disease.	accuracy of predicting disease.	chatbot may not be able to handle it properly.
Trust in health chatbots[4]	Not given	Not given	Not given	.Not given	Trust is dynamic	Not given	Not given
A Medical ChatBot: a System based on ML and NLP for supporting Women and Families during Pregnancy [5]	Support Vector Machine (SVM) algorithm,Porter Stemming algorithm and word similarity	Medicine details and dosage. Disease prediction.	Not given	They used four dataset for different cities of different sizes for giving the information about the heart disease. 60% of each dataset was taken for training the classifier and remaining 40% was taken for testing. Cleveland had highest training count. Three algorithms were also tested which were KNN, Naïve Bayes and SVM. SVM algorithm had higher accuracy.	This system is useful for user to freely ask medical dosage related queries by voice as well as text. System gets output for medicine API and speak out and display all medicine names. It also provides disease prediction using SVM algorithm	Voice-text conversations is possible.	Does not have navigation functionality.
MamaBot[6]	Microsoft Bot Framework,LUIS(Lan	Searching of pharmacies	Not given	Not mentioned	This system presents an AI-	Provides navigation to	Voice-text conversatio

	guage Understanding intelligent Service)	and hospitals nearby. Tips on nutrition for children. Children emergency management			based chatbot useful to support and help pregnant women, mothers and families with young children about any doubts or problems that may incur during the pregnancy/childhood.	nearby pharmacies by using user's location.	ns is not Possible. User verification is not provided.
Implementation of a ChatBot System using AI and NLP[7]	Lemmatization and POS Tagging, Semantic Sentence Similarity,Artificial intelligence Modelling Language (AIML)	Viewing user profiles and retrieves attendance and grade/pointers. Viewing placement details. Providing all admission related information.		Not mentioned	This system allows student and employees to freely ask their queries. The chat bot provides fast and efficient search for answers to the queries and gets the relevant links to their question.	User is verified then its profile is displayed.	Voice-text conversations is not Possible.
Pribots: Conversational privacy with chatbots.[8]	Personalised privacy policies	Delivering privacy policies and updating the policies.	Not given	Provides a more interactive way of delivering policies to the user,and gives control to the user.	It is concluded that the privacy policies can be changed according to the user	Flexible privacy policies keeps user's trust in chatbot.	Certain type of policies won't be flexible.
Developing Disease Classification System based on Keyword Extraction and	It gives K-mean Algorithm, LAMSTAR Network, Collecting the medical dataset, Symptoms comparing using iterative search	It mainly focuses on processing of text and feature extraction and by	Not given	In this, results are evaluated by precision, recall and F1-scores of disease and	It is concluded that the system is more towards processing of text and feature extraction by using NLP and	It has calculated the results of multiple keywords and key-phrases and	In this real time and problem related local context based

Supervised Learning[9]		classifying, it suggests the prevention for diseases.		on the basis of resulting accuracies naive Bayes performs poorer than Random forest and decision tree.	machine learning techniques to provide preventions of diseases.	got good results with small datasets.	datasets have not been taken into consideration. They have used small datasets.

4. CONCLUSIONS

Chatbots are an easy to use way for any individual. At the same time, it is economical for the healthcare organizations too. With the help of deep learning and artificial intelligence, it is possible to make the chatbot behaving in more humanly manner. Though chatbots are widely available in English, there is a dearth of chatbots which understand other Indian local languages. As HEALTHBOT is trained to converse in Marathi, it would be especially beneficial to rural population of Maharashtra. It would be helpful to school-going teens where they can talk openly about their symptoms without being judged and beign guided about next step. Besides, this bot can be taken under use to have a preliminary treatment of a disease precisely and instantly. Though our bot is currently in a premature stage, the future scope of this bot can be improvised a lot. It can be physically present in hospitals to perform basic height, weight check, temperature check etc. More improvement of this bot will ensure minimal time consumption and more accuracy in making the prescriptions.

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