Comparison of Different Algorithms for Disease Prediction and a Review of Already Existing Chatbots in Healthcare

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Abstract: *People have become health-conscious owing to the spread of Covid 19 thereby increasing self-awareness. Whenever someone feels low, it is a human tendency to google the symptoms, which eventually leads to misinformation. Here, Healthcare Chatbots come in handy which can map the entered symptoms to diseases in their vast database. These chatbots use Artificial Intelligence techniques and can help provide 24*7 user engagement without human intervention. It mainly aims to create an alternative to the conventional method of visiting a hospital and making an appointment with a doctor to get a diagnosis.*

Keywords: Chatbot, disease prediction, Health, Machine Learning

1. Introduction

Chatbot, as the name suggests, is a program that can interact with the user via text or voice interface. It behaves as a virtual assistant using machine learning and natural language processing replacing human effort. The idea behind deploying a Chatbot is to create an environment where humans can communicate with digital devices as with a real person.

Chatbots came into existence in the 1960s with the introduction of ELIZA and PARRY and ALICE in 2006 but they became popular in 2016 through Facebook Messenger App and then Google came up with Google Assistant. Since then, Chatbots are widely used on various websites for providing customer support. Chatbots find their application in every possible sector ranging from e-commerce, education, and entertainment to health, finance, news, marketing, etc. We do engage with a lot of chatbots in everyday life without even realizing it, for example, Apple's Siri, Amazon's Echo, etc.

The basic workflow of a Chatbot consists of mapping the input provided by the user to an already existing database related to that field and after careful evaluation giving the correct answer, using Machine Learning and NLP techniques to get better at further predictions.

The healthcare industry adopted chatbots in 1966 through ELIZA which acted as psychotherapists but had limited capabilities. Today, patients are worried about their 360-degree well-being and there is a shortage of doctors as compared to increasing patient demands. Healthcare chatbots can act as a first contact point for primary care. It can help bridge the gap by making relevant information accessible thereby improving the quality of healthcare service to the patients. It can not only serve as a boon to the patients but also help hospitals manage the increasing demand for healthcare facilities. They can deploy these chatbots to communicate with different people visiting their websites, helping them discover specialists and further book their appointments. Furthermore, it can be used to answer general queries related to hospitals or doctors, sending reminders, basically for user's engagement 24*7.

The proposed paper aims to analyze the different algorithms used to develop chatbots. Furthermore, we plan to find the acceptability of these chatbots by the general public as an alternative to visiting the doctor. The accuracy of prediction plays a very important role especially in the healthcare industry as human life, the most precious asset, is at stake. So, we need to review the already existing chatbots in the healthcare industry and how reliable they can be.

2. Methodology

A. Algorithms used
The increase in the amount of data in the healthcare industry has forced us to use Artificial intelligence to extract useful insights. The most used AI algorithms to develop chatbots are as follows:

- Naive Bayes is considered the most efficient algorithm when it comes to the healthcare industry because of its high probability distribution. Being a supervised algorithm, it helps in classifying the symptoms thereby predicting the disease.
  - $P(A/B) = P(B/A) * P(A) / P(B)$
  - i.e. we need to find the probability of disease when symptoms are already present.
- The K Nearest Neighbors algorithm is employed in healthcare due to its great classification accuracy while dealing with large data. It also helps in finding hidden insights and relationships leading to improved accuracy in diagnosis. It is used in the diagnosis of health diseases in patients.
- Decision Tree has tremendous potential of developing a reliable decision model with high accuracy. It is a powerful algorithm that fits complex data. It is used for the early prediction of diseases like breast cancer by categorizing patients if their tissues are benign or cancerous.

- Random forest is the mixture of decision trees with bagging and feature sampling. It overcomes the problem of overfitting in the decision tree thereby increasing the accuracy. It fits several decision tree classifiers on various samples of the data. It finds application in ECG and MRI scan analysis.
- Support Vector Machine serves as a promising classification algorithm for the healthcare industry as it attempts to find a hyperplane that separates the classes and tries to maximize the margin under the constraint that no patient is misclassified into having a disease. It works best for linearly separable data but its kernel approach of transforming data into high dimensional space makes it quite efficient. The accuracy can be measured using sensitivity and specificity.
  - sensitivity= True Positive / True Positive + False Positive
  - Specificity= True Negative / True Negative + False Positive

B. Existing Healthcare chatbots

One Remission, a chatbot developed by a New York company, aims to fight cancer by making their lives easier and safe. It provides relevant information to the patients ranging from personalized diet plans, exercises, stress management to all post-cancer practices. It creates an Integrative Oncologist in your pocket.

Youper, developed by a renowned therapist Andrea and a psychiatrist Jose, aims to fight anxiety and depression and restore normal emotional health. It makes Cognitive Behaviour Therapy accessible to everyone. Using it, one can track their mood, get personalized medication and monitor emotional health.

Babylon Health, founded in 2013, is a British health service and medical consultation company. It has a feature to report the symptoms and get a diagnosis through a chatbot and also, to directly consult a doctor on their app and get personalized prescriptions.

Florence is a chatbot that functions as a nurse on Facebook Messenger. It is made keeping in mind the older patients who forget to take their medicines on time. One has to feed in the name of the medicine and the number of times to be taken in a day following which it sends messages to remind you to pop in the pill. It can monitor health i.e track mood, period, etc. It can also refer to the nearest doctor or pharmacy whenever required.

Healthily is a symptom checker which is powered by AI. It is an app where one can easily find the nearest pharmacy, doctor, or test centers. It offers a user-friendly symptom checker which generates a report of diagnosis and mentions if any immediate action is needed.

Ada Health is one of the most popular health assessment solutions in the UK. It accesses the user's health by mapping the indicated symptoms into its vast database. It has 10 million users and 50 in-house medical experts who have completed 25 million symptom assessments till now. It aims to become the standard diagnostic tool for doctors.

Sensely is another chatbot that features Molly, a virtual medical assistant. It accesses the user's symptoms using text and makes a diagnosis.

Cancer chatbot, available on Facebook Messenger, aims to provide various resources to cancer patients. It is curated by cancer patients to reduce the burden on the family members by creating a one-stop solution for all cancer-related resources from medication to post-cancer practices.

Woebot is a free-to-use mental health solution that uses cognitive behavioral therapy to listen to and advise patients. It offers support to cope with mental health issues.

C. Proposed Work

We have a supervised problem at hand where the user feeds in the symptoms and we need to predict the disease. So, we tried to build a GUI based disease predictor system using 4 supervised algorithms namely, Naïve Bayes, K-Nearest Neighbor, Decision Tree and Random Forest.
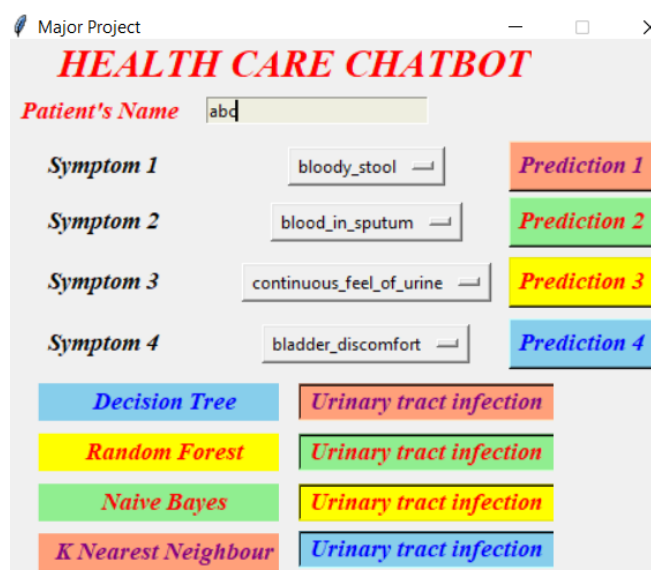
We trained the model on a dataset that was collected from a study done at New York Presbyterian Hospital on the patients admitted during 2004. We achieved an average accuracy of 95% which is somewhat reliable and the bot can very well act as a self-diagnostic tool.

3. Conclusion

According to the statistics, 75% of global healthcare is invested in AI. But it has its limitations, for example, despite using modern techniques, chatbots are not able to correctly

mimic human understanding capabilities. Also, we do not have a reference to evaluate the performance of chatbots. Because of this, it requires human intervention which is a costly affair altogether. We need an automatic evaluation that is reliable and less time-consuming and easily scalable at less cost.

So, chatbots can never replace the work of doctors yet they can help reduce the workload by providing some facilities like performing self-diagnostic checks with the help of AI and ML algorithms. The system can be somewhat reliable and could reduce the rush to OPD's thereby reducing the workload on hospital staff. Furthermore, it can help schedule appointments, answer general queries related to hospitals or doctors, sending reminders, basically for user's engagement 24*7.

The chatbots replacing humans for certain functions makes the process more effective while saving money for both in the short and long terms. A win-win situation that can only get better as the bots become more and more "learned" in their tasks.

4. Related Work

Paper [1] aims to analyze the acceptability of chatbots using the theory of planned behavior and theory of reasoned action from a behavior change perspective. It captures the history of chatbots from 1966 to 2019. Theory of planned behavior showed 68% of people use Chatbot because of productivity, 5% use it because they feel stupid asking those questions to real doctor and 12% use it for socializing. Theory of reasoned action states that use of social media such as telegram, Facebook Messenger draws user's attention to chatbots. Human emotions in Chatbot replies, Ease of use, anonymity are some factors which initiate behavior change.

Paper [2] conducted a survey to assess the acceptability of Chatbot moderated by perceived stigma, consultation source and severity. In total, 237 people participated and the results suggested that chatbots are more acceptable in case of stigmatized diseases because of anonymity and less in the case of severe diseases. 65% of participants were above 45 years of age and 59.5% weren't aware of chatbots.

Paper [3] analysed the spread of mobile consulting in providing healthcare services in rural and urban sites. It reviewed 5 urban slums, two rural settings in which 5322 urban households and 424 stakeholders from urban and rural sites participated. They found out that despite readiness, there was lack of service laboratories, supply chains to offer care and responsiveness.

Paper [4] conducted a survey on social media to analyse the acceptability and utility of chatbots in healthcare. Three main themes emerged i.e. AI hesitancy, Understanding of chatbots and Motivation for health chatbots. Many interviews were taken and most of the people were concerned about the accuracy, inability of AI to empathise. It showed 67% acceptability which was because of dislike of computers, poor IT skills and less trust in AI.

5. Acknowledgement

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