

The Health Chatbot's in Telemedicine: Intelligent Dialog System for remote support using Artificial Intelligence

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Abstract - Chatbots, also referred to as conversational interfaces, provide users a new method to communicate with computers. Traditionally, utilizing a search engine or filling out a form was required to get a software application to answer a query. A chatbot enables users to ask queries as easily as they would to a real person. The most well-known chatbots currently are voice chatbots: Alexa and Siri. However, chatbots are currently being adopted at a high rate on computer chatplatforms. Natural language processing ("NLP") is the technology that is driving the chatbot revolution. The accuracy and efficiency of natural language processing have significantly increased thanks to recent developments in machine learning, making chatbots an attractive alternative for many businesses. This advancement in NLP is spurring a ton of new research, which should result in ongoing advancements in chatbot effectiveness in the years to come.

Keywords - Chatbot, NLP, RNN

1. INTRODUCTION

The field of computer science known as artificial intelligence (AI) focuses on building intelligent machines that behave and act like people. Speech recognition, learning, planning, and problem-solving are some of the fundamental methods used. We further provide deep learning by collaborating with the AI area known as Machine Learning. Computers may create models from sample data using machine learning, which enables them to decide for themselves depending on inputs from data. One of the main uses of machine learning is in chatbots, which are used to address issues or complaints. Natural language processing (NLP) is the basis for chatbot interactions with users. A chatbot is a piece of artificial intelligence (AI) software that can mimic a natural language interaction with a user through messaging services, mobile apps, websites, or the phone. It is referred to as one of the most cutting-edge and hopeful examples of human-machine interaction. A chatbot is just the natural progression of question-answering software based on Natural Language Processing (NLP) from a technology standpoint.

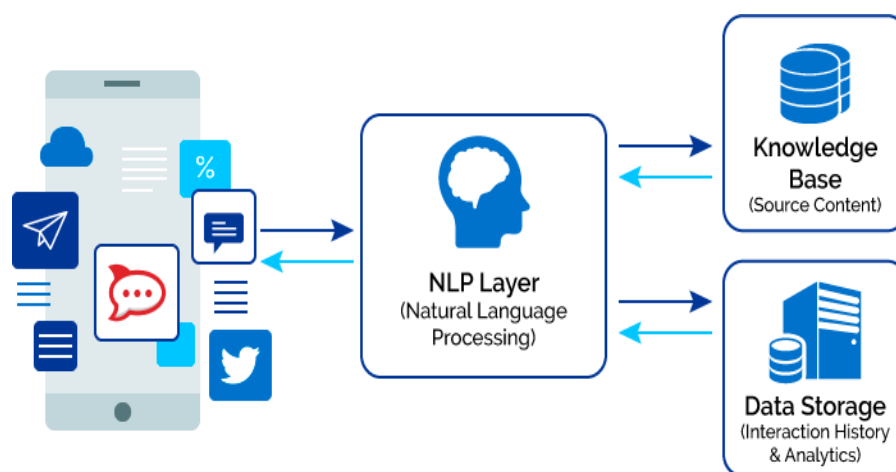


Fig 1: Chat bot working architecture

Basic technologies in Chat bot are: -

Convolution Neural Network (CNN): Convolution neural network are a type of neural network which have been widely used for imagerecognition tasks.

Recurrent Neural Network (RNN): Recurrent Neural Network are types of neural networks designed for collecting information from sequences of series data. In RNN the outputs from previous steps are fed as input to the current step.

Text-to-Speech: Text-to-Speech allows developer to create natural synthetic human speech as playable audio. It converts text or SSML (Speech Synthesis Markup Language) into audio data likemp3[4].

Speech-to-Text: Speech-to-Text transforms artificial human audio data into plain text. To accomplish speech recognition, there are a few voice request methods. The advanced speech-recognition technologies of Google are the foundation of Speech Notes. In actuality, Google receives all of your speech, processes it using robust parallel servers and algorithms, and then sends the results back to Speech Notes as a stream of potential transcription outcomes. With the right handling of these results and set of commands to the Speech-To-Text engines we are able to achieve results that do not fall in accuracy even when compared to the most professional and expensive software available on the market [2].

2. LITERATURE WORK

Chatbot are majorly divided into two types. First one being the Rule based chatbot which is also referred to as Traditional chatbot. The second type is Machine learning enabled chatbot which is also referred to as Artificial intelligence chatbot. The further information about these types are discussed in further sections. [12] Chatbots/Voice assistants have been a social requirement for the faster completion of human task like querying and accessing thefiles. The first ever thought of a chatbot was in a traditional manner, which does the tasks by following the rules and commands directed to it. The context might be analyzed by the example of a person interacting with the chatbot let's say "Hello good morning", the response would be an output generated with the help of random generator from a response already given in a list. This does nothing as of thinking on its own but follows the instructions and responds on the criteria. [13].

Chatbots with machine learning concepts enabled are those that also include artificial intelligence capabilities. These once more include chatbots that employ NLP (Natural Language Processing), AIML (Artificial Intelligence Mark-up Language), and chatbots that support deep learning. Similarly, the first type being NLP chatbots are implemented using the contexts of NLTK (Natural Language ToolKit) packages such as the intent deciding for every words and tokenizing is done to assign the scores for the text. [14]

Chatbots are the biggest technological advancement of the present that have undoubtedly supplanted all other technologies. Chatbots are gaining popularity because they can communicate with humans through the included interfaces in a simple and natural way. Due of the simplicity of human information provision, chatbots have aided in the digitalization process. With the growth in World Wide Web, it becomes difficult for any user to access the required information quickly and in a simple way [15][16].

3. THEORETICAL FOUNDATIONS

Living a healthy, moral life is crucial and necessary. However, it is now more challenging to get a doctor's opinion on a variety of health conditions. The goal is to use AI to build a medical chatbot that can diagnose illnesses and give basic information about them. Certain chatbots serve as medical encyclopedias, educating patients about their conditions and promoting better health. Most of the time, users are unaware of all the available treatments or symptoms for a given ailment. The patient must travel directly to the hospital for a check-up for minor health conditions, which takes extra time. The handling of phone calls for complaints is also very busy. Such a problem can be solved by using medical chatbot by giving proper guidance regarding healthy living. The medical chatbots functioning depends on Natural language processing (NLP) that helps users to submit their problems about the health. [12][15]. Only when the user can detect all diseases and receive the essential information will it be able to benefit. Their health conditions will be diagnosed via text-to-text, and a unique diagnosis based on their symptoms will be provided. Without physically being present in the hospital, the user can utilize the chatbot to ask any personal questions about health care. Using Google API to convert voice-to-text and text-to-voice. Query is sent to Chatbot and gets related answer and display answer on android app. The System's major concern behind developing this web based platform is analyzing customer's sentiments. [15][17] Chatbots can streamline the interaction with electronic health records and decrease documentation burden. "Modern electronic health records rely on clinicians to either type or dictate consultation notes, with increased cognitive load, information loss, and distraction from other tasks in the clinical encounter," says Liliana Laranjo, a Research Fellow at the Centre for Health Informatics at Macquarie University in Australia.

“Conversational interfaces can employ recent advances in speech recognition, natural language processing, and artificial intelligence to provide clinicians with tools to automatically document elements of the spoken clinical encounter.”[16][19].

A. System Requirement

There is a need for a system that respond to various queries in real- time, to advice and inform expectant mothers during their pregnancy. Several smart services have been deployed, bundled with health information systems, and other digital services. While such solutions better services in the healthcare settings, they may not be available to the masses in the rural. Besides they rarely dispense this information precisely and or accurately. A new digital ecosystem, represented by chatbots seem to offer promising solution by embodying the function of a virtual healthcare expert, who is always available to provide information in the required precision. Powered by AI and machine learning algorithms, chat- bots are forecasted to bring forth accuracy, precision and availability of information when used. [17][18]

B. User health condition

Obese and overweight individuals are at an increased risk of major illnesses and disorders. Obesity is on the rise and is not just a problem in rich countries; it is also a problem in emerging countries. Mobile applications (apps) are used in public health as an intervention to track meals, activity, and weight, which is believed more accurate than depending on users' self-report measures, for the purpose of weight control as cellphones have quickly become a commonplace household item. A solution called “Smart Wireless Interactive Healthcare System” (SWITCHes) is developed to facilitate objective data reception and transmission in a real-time manner [19][20]. Based on the user data acquired from SWITCHes app and the auxiliary data from medical instruments, not only SWITCHes app can engage user with tailored feedback in an interactive way, in terms of artificial intelligence powered health chatbot, but the healthcare professional can provide the more accurate medical advice to user also. This paper presents an overview of development and implementation of SWITCHes. [20]

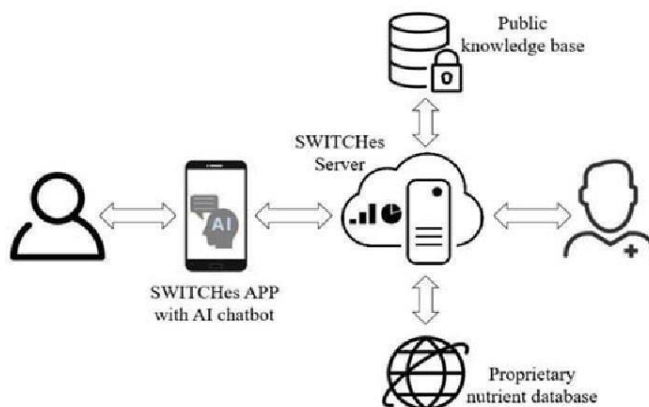


Fig 2: Operational concept of SWITCHes

C. Algorithms Implemented

1. DATA CLEANING ALGORITHM

```

Algorithm 1 Data Cleaning
1: procedure CLEANING THE DATASET FOR THE RAW DATA GIVEN
2: Input: Raw dataset as collected.
3: Output: Cleaned dataset.
4: readline ← Read entire dataset
5: if readline does not contain any unwanted characters then return false
6: else remove the unwanted characters from readline
7: return readline
    
```

Fig 3: Data Cleaning Algorithm

It showcases what would be the input along with the output as in 2nd and 3rd line of the Algorithm. Line 4 to 7 depicts about the actual procedure that is reading the dataset, checking if the read dataset contains any unwanted characters, if yes then remove such characters from the object chosen and at last return the cleaned dataset.

II DATA PRE-PROCESS ALGORITHM

```

Algorithm 2 Data Preprocessing
1: procedure PREPROCESSING THE CLEANED DATASET
2: Input: Cleaned dataset.
3: Output: Preprocessed data.
4:   readline ← Read entire dataset
5:   Q = dict()
6:   for all q, r in readline do
7:     Q[q] = readline[r]
8:   return Q
    
```

Fig 4: Data Preprocessing Algorithm

Line 4 to 8 depicts about the actual procedure that is reading the dataset, creating a dictionary object, a loop that runs for each value in the read dataset object and assigns the values in the form of key value pair. Here key is considered to be as the question or query and value is the answer or response for the respective query. The last line of the algorithm is it returns the dictionary object.

III. RECURRENT NEURAL NETWORK(RNN)

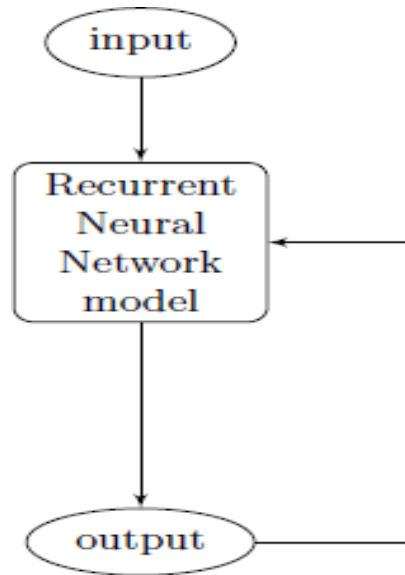


Fig 5: RNN Usage

The initial state would be already set by the model which will be hidden. The input can be read in the form of X as shown in the figure and for every sequence the output is generated which will again be passed to the next input as hidden state. When X is stopped the output is finalized for the model. The same context is used in the text classification for voice assistant where, for every word the response is kept on predicting and the final response is predicted when the input is stopped.

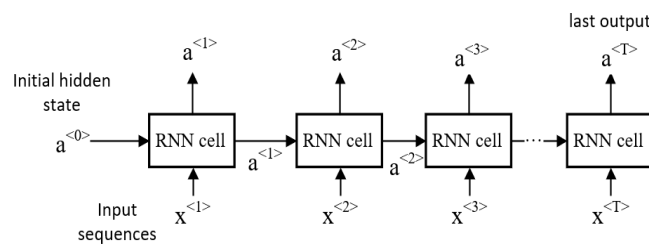


Fig 6: RNN working structure

IV TF-IDF

In information retrieval, tf-idf or TFIDF, short for term frequency inverse document frequency, is a numerical statistic that is intended to reflect how important a word is to a document in a collection or corpus. In text mining, user modeling, and information retrieval searches, it is frequently employed as a weighting factor. To account for the fact that some words are used more frequently than others overall, the tf-idf value rises according to the number of times a word appears in the document and is offset by the number of documents in the corpus that contain the term. One of the most common term-weighting techniques used nowadays is tf-idf. According to a 2015 survey, tf-idf is used by 83% of text-based recommender systems in digital libraries.

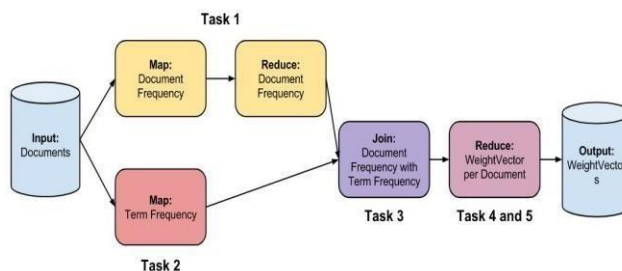


Fig 7: TF-IDF Model

Term Frequency: is a scoring of the frequency of the word in the current document.

$$TF = (\text{Number of times term } t \text{ appears in a document}) / (\text{Number of terms in the document})$$

Inverse Document Frequency: is a scoring of how rare the word is across documents.

$$IDF = 1 + \log(N/n), \text{ where, } N \text{ is the number of documents and } n \text{ is the number of documents a term } t \text{ has appeared in.}$$

V. COSINE SIMILARITY

TF-IDF is a transformation applied to texts to get two real-valued vectors in vector space. The Cosine similarity of any two vectors may therefore be calculated by taking their dot product and dividing it by the product of their norms. This results in the cosine of the vectors' angle. The cosine similarity between two non-zero vectors is a metric of similarity.

Using this formula, we can find out the similarity between any two documents d1 and d2.

$$\text{Cosine Similarity } (d1, d2) = \text{Dot product } (d1, d2) / \|d1\| * \|d2\|$$

Where d1, d2 are two non-zero vectors.

VI. DJANGO

Django is a Python-based free and open-source web framework, which follows the model template-view. The Django Software Foundation (DSF), a non-profit organization, looks after it. Django's main objective is to make it simpler to create intricate, database-driven websites. The framework places a strong emphasis on the reuse and "plug-ability" of components, reduced code, low coupling, quick development, and the don't repeat yourself philosophy. Everywhere, including in the configuration files and data models, Python is used. If external code adheres to the rules of reusable apps, it can be plugged into a regular project using Django's configuration system. More than 2500 packages are available to extend the framework's original behavior, providing solutions to issues the original tool didn't tackle: registration, search, API provision and consumption, CMS, etc.

A web application waits for HTTP requests from the web browser (or other client) in a standard data-driven website. The program determines what is required in response to a request based on the URL and sometimes data from a POST or GET request. It may then read or write data from a database or carry out additional operations to fulfill the request, depending on what is necessary. The application will then return a response to the web browser, often dynamically creating an HTML page for the browser to display by inserting the retrieved data into placeholders in an HTML template.

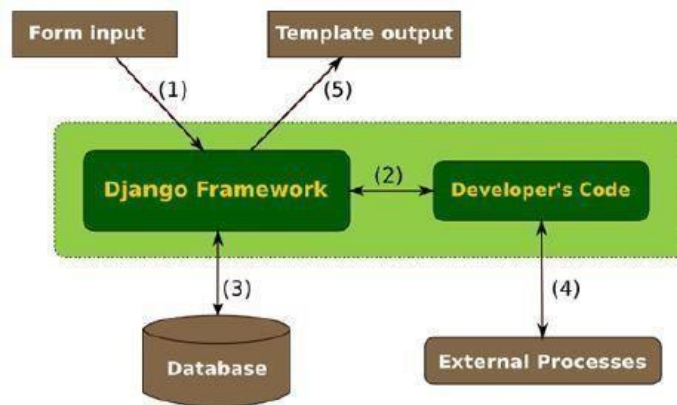


Fig 8: Django Framework

PEARSON CORRELATION

The Pearson correlation coefficient, commonly known as Pearson's r , the Pearson product-moment correlation coefficient (PPMCC), or the bivariate correlation, is a statistic used in statistics to determine the linear relationship between two variables, X and Y . The fact that the value falls between -1 and 1 is a result of the Cauchy-Schwarz inequality. It has a value between $+1$ and 1 , where 1 is total positive linear correlation, 0 is no linear correlation, and -1 is total negative linear correlation. In the sciences, it is widely applied. The sample and population Pearson correlation coefficients have absolute values that are on or near 0 and 1 . The Pearson correlation coefficient is symmetric: $\text{corr}(X, Y) = \text{corr}(Y, X)$.

4. PROPOSED METHODOLOGY

Any problem statement must first be produced, then the problem must be investigated and then a solution must be developed. We have noticed that using a body part scanner or staying in touch is always required to complete a task in the system. The medical chatbot machine learning model, which not only won't employ the heritage model but machine learning approaches as well, is created to assist the people who always work being in contact with the system or gadgets. On messaging apps, chatbots may reach a larger audience and are more efficient than people. They may develop into a capable information-gathering tool in the near future. This model is built to overcome being in contact with the gadgets all the time to accomplish the respective task. Both the automatic models and the legacy models (traditional model) are used to implement this. The same technology can be utilized in a variety of fields to make human tasks easier and more effective. Even those who are specially abled (but can talk) can benefit from it because it completes the task even without being in contact with the system or devices. It can be utilized as an internal application or a web application to complete an internal task.

By utilizing the databases used and the following algorithm or processes, a system may be created that assists patients in learning the remedies from the symptoms they submit to the chatbot. The patient can use this system to send an image of the affected area, and the system will diagnose the ailment and provide the results. Convolution neural networks (CNN), recurrent neural networks (RNN), text-to-speech, and speech-to-text are some of the approaches used in this system. The chatbot is created using the aforementioned strategies so that it can rapidly respond to patient questions with predetermined results after receiving them. This is beneficial for doctors as well because it makes it simple for them to communicate problems or diseases, but a chatbot cannot take the role of a doctor. This reduces human effort because people don't have to go far to see a doctor for a minor issue because chatbots can predict remedies. This kind of chatbot would make it simpler for the patient and the doctor to access the ailment and find treatments for it.

5. RESULTS

After the implementation part of the model the next task is to check out the results, test whether the result obtained is according to the estimated result and the reasons behind the false outputs or incorrect responses.

```
Administrator: Command Prompt
C:\Users\roshan\Desktop\New Chatbot Project\Old Project\healthChatbot>python manage.py migrate
Inltk_data Downloading package punkt to
Inltk_data C:\Users\roshan\AppData\Roaming\nltk_data...
Inltk_data Package punkt is already up-to-date!
Inltk_data Downloading package wordnet to
Inltk_data C:\Users\roshan\AppData\Roaming\nltk_data...
Inltk_data Package wordnet is already up-to-date!
Operations to perform:
  Apply all migrations: admin, auth, chatbot, contenttypes, sessions
Running migrations:
  No migrations to apply.

C:\Users\roshan\Desktop\New Chatbot Project\Old Project\healthChatbot>
```

Fig 9: Initial page of Implementation

The above Fig 9 demonstrates the initialization of the project where we provide the migrate option for manage.py python file because this would convert the models.py to SQL queries and we can directly access the Database now.

```
C:\Users\roshan\Desktop\New Chatbot Project\Old Project\healthChatbot>python manage.py runserver
Performing system checks...

Inltk_data Downloading package punkt to
Inltk_data C:\Users\roshan\AppData\Roaming\nltk_data...
Inltk_data Package punkt is already up-to-date!
Inltk_data Downloading package wordnet to
Inltk_data C:\Users\roshan\AppData\Roaming\nltk_data...
Inltk_data Package wordnet is already up-to-date!
System check identified no issues (0 silenced).
June 10, 2020 - 15:26:42
Django version 2.0.8, using settings 'healthChatbot.settings'
Starting development server at http://127.0.0.1:8000/
Quit the server with CTRL-BREAK.
```

Fig 10: Run server Option for the Project

The above Fig 10 demonstrates the run server options which basically connects the prompt or any initialization software we use to the browser. Here we get the address of access which is used to see the initial page of the Project.



Fig 11: Initial page of Chatbot

The above Fig 11 shows the initial page of the chatbot project where the user can start conversing with the device. Here the user need to interact with the machine and state their problems.



Fig 12: Disease Detection for the Symptom

The above Fig 12 shows the process of User and Machine interaction where the user provides with information of their symptoms and problems they might be facing and according to the provided information the chatbot provides the outcome.

The below Fig 13 shows the detailed report of a patient under observation. This report shows various category of information like age, disease, symptoms, cause, treatment and precautions.

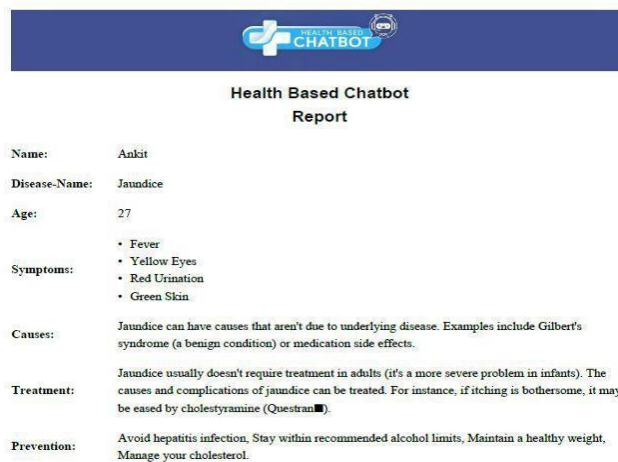


Fig 13: Detailed report of process in PDF format

By describing the performance qualities and assessing the outcomes, the evaluation of the software aims to determine the chatbot's quality. It also serves as a reflection of current work in progress and a plan for future work. We may conclude from the above-mentioned results that the Medical Chat-bot has been created to the highest standard feasible and can be trusted for use in the future. The effectiveness and influence of chatbot use on health outcomes require further study. The importance of this should be taken into account by businesses in this industry. We discovered in our investigation that there was a paucity of data sharing on chatbot effectiveness. Chatbots in the healthcare space have the potential to expand patient care continuity, providing users with access to validated medical information on-demand, and recommending diagnoses at the first sign of illness. When testing the last prototype, we got findings suggesting that the participants did not have a problem with getting information from a chatbot instead of a human. The information that they got was not seen as less trustworthy, this could be supported by the fact that the chatbot provided a source for the information it gave. It has been interesting to investigate how the participants interacted with the chatbot and how they reported on it afterwards. Our findings have some indicators leading towards that a chatbot could be a good alternative.

6. CONCLUSION

A piece of software created to mimic communication with real people, particularly over the Internet. It is a virtual companion that connects into websites, programs, or instant messengers and communicates with us via text messages. It aids business owners in building stronger customer relationships. Artificial intelligence and natural language processing are used by chatbots, which are software programs, to interpret human speech and help users reach their goals with the least amount of effort. For your customer experience contact points, think of a virtual assistant. This is the reason chatbots are so popular. For those that are willing to dive in headlong and create what consumers want, it might be a major financial opportunity. This robot possesses artificial intelligence, sometimes known as a brain. Speaking to it doesn't require you to be overly specific. It comprehends words rather than just commands, and the bot continually improves as a result of the interactions it conducts with humans. The excitement that has surrounded chatbots over the past few years cannot be disputed. Whatever your opinion on the technology—whether you think chatbots are just a passing fad or that they will completely change the way people communicate and interact—the effect chatbots are having on online interactions is real and measurable.

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