AI Based Chatbot for Hospital Management System

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2022 3rd International Conference on Computing, Analytics and Networks (ICAN) | 978-1-6654-9944-6/22/$31.00 ©2022 IEEE | DOI: 10.1109/ICAN56228.2022.10007105

***Abstract*—The healthcare sector represents one of the most significant segments of the economy. A reliable healthcare system ensures a strong economy by increasing life expectancy, contributing to national growth, and reducing the burden of families. The purpose of this project is to implement a proper healthcare management system integrating all the basic functionalities powered by an Artificial Intelligent chatbot that is capable of having a very organic conversation with the user and solving their queries using knowledge base. The knowledge base is a real-time data collected in a JSON format which is pre-processed to make it ready for further processing using bag of words. The information is received and delivered in both speech and text formats. The chatbot can provide navigation links according to the requests of a user. Furthermore, it is capable of predicting the problem by performing symptom diagnosis and recommending a doctor to be consulted or any immediate measures to be taken. In addition, it also provides information regarding diagnostics beforehand.**

Keywords— Chatbot, Appointments, Diagnosis, NLP, Long-Short Term Memory (LSTM), Recurrent Neural Networks (RNN)

I. INTRODUCTION

An artificial intelligence(AI) chatbot is a computer programme that mimics human communication. It is a piece of software that communicates with humans using written language. It is frequently embedded in web pages or other digital applications to answer customer inquiries without the need for human agents, resulting in low-cost and hassle-free customer service. Chatbots based on machine learning produce an AI chatbot that is very capable of having an organic conversation with the user and answering their queries. Chatbots use the data that is provided to them to answer queries as accurately as possible using various training algorithms. In our proposed system we create a conversational chatbot that is integrated into a hospital website.

It is trained with machine learning algorithms and serves as an extremely efficient interface between the user and the application. There is no predefined format in which users can ask their questions. The chatbot responds to the query in the best way possible. Users have the option of submitting a query in both text and speech format. Users can use this chatbot to access hospital information, doctor availability, diagnostics, and other related data. They are navigated to different pages according to their requests, which makes it easier and faster for them to explore. They can schedule appointments and identify the problem by describing the symptoms in order to be prepared. This allows them to take any necessary precautions and schedule an appointment with the doctor as soon as possible.

II. RELATED WORK

A literature gives overview of previous related works in the current domain. With the Literature review, it can bring focus on area of research and broaden your knowledge of the domain.

In [1], algorithms such as Gradient descent method, Natural Language Processing(NLP), and feed-forward neural network(FNN) are used to create the chatbot. Gradient Descent (GD) is the cost-minimization technique that examines the coefficients of a function (f). It is a key optimisation approach for determining the minimal cost function. The model may be conveniently stored in memory with little noise using the GD technique. Computational linguistic rule-based human language modelling is combined with statistical, deep learning models and machine learning in NLP. These technologies work together to allow computers to analyse human language in the form of text or speech data and comprehend its entire meaning, including the speaker's or writer's purpose and mood. This chatbot answers questions about hospital information, such as specialist availability, OPD hours, room registration, bed capacity, doctor availability and emergency information, among other things. The suggested chatbot acts as if it were a genuine hospital receptionist, assisting users. It offers consumers complete medical support 24/7.

KNN (K nearest neighbour algorithm) and NLP (Natural Language Processing) algorithms are used to create the chatbot. The K-Nearest neighbour method is one of the Supervised Learning techniques and is one of the most popular Machine Learning algorithms. KNN works by classifying new data into most similar class label. The created chatbot application is an android application in which the user may tell the chatbot about their symptoms, and the chatbot will then tell them what health measures they should take [2].

N-gram, which is a series of N words, is used to construct the chatbot application. So for example, “Final demo” is a 2-gram (a bigram), “This is a final demo” is a 4-gram, and “Good to go” is a 3-gram (trigram).The TF-IDF (Term Frequency-Inverse Document Frequency) which works by

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examining whether the word belongs to a document in a large collection of documents. This can be examined by multiplying two metrics: the word's inverse document frequency over a collection of documents and the number of times a word occurs in a document. It's used to get the keyword out of the user query. To get the best response for the inquiry, each term is weighted down. The Web-interface is designed for users to enter their query. The programme is enhanced with security and effectiveness modifications that ensure user protection and integrity when getting answers to queries. This chatbot assists users with basic health information. When a person initially visits the website, they must register before asking the questions to chatbot. If the answer is not available in the database, the system employs an expert system to respond to the queries [3].

An AI chatbot for college activities is developed using Deep Neural networks. The data regarding college activities is being collected in the JSON format and Bag of word technique is used in pre-processing of data. Gradient Descent is used for optimizing the model to process the patterns and give best possible response to the question asked by the user. pyttsx3 python library is used for speech recognition to enable users to give input questions using voice. The model accuracy is found to be around 93 percentage for 1200 epochs of training the model [4].

Proposed work have coined a programming language for natural language processing, ELIZA which is operated within the MAC time-sharing system and makes certain natural conversation between man and computer possible. Input sentences are analysed on the basis of decomposition rules which are triggered by key words appearing in the input text. Responses are generated by reassembly rules associated with selected decomposition rules[5]. The proposed system has Online Enquiry and Online Chatbot System which is developed using various programming languages on a user-friendly graphical interface to send and receive response for the queries. Mainly it uses SQL (Structured Query Language) for pattern matching which is been stored in program [6]. Proposed an artificial chatbot using NLP (Natural Language Processing) which can be done in two ways the first via written text and the second is via verbal or voice communication. Written communication is much easier than verbal communication. This paper introduces an interest in some emerging capabilities for evolving speed understanding and processing in virtual human dialogue systems [7].

Planned and investigated the implementation of ALICE Chabot system as an application named as college enquiry chat bot. A keywords-based human-computer dialog system makes it possible that the user could chat with the machine in natural language [8]. Projected and examines the potential use of dialog-based ALICE bots in disseminating terrorism information to the general public. The proposed system has utilized feedback to test the chatbot accuracy and customer satisfaction [9]. Projected a chatterbot based on AIML (Artificial Intelligent Markup Language) structure for training the model and uses Microsoft voice synthesizer for providing speech recognition system and natural language processing [10]. In the proposed work several hybrid models that combine different classification techniques, namely, Markov models, artificial neural networks (ANNs), and the All-Kth-Markov model are used to resolve prediction using Dempster's rule. Such fusion boosts the accuracy of ANN, particularly, when dealing with a large number of classes [11].

III. Proposed System

The proposed system focuses on integrating all basic features in one place in an application and powering it with an AI chatbot further adds new functionalities like easy navigation, access to the data on availability of doctors, diagnostics information, symptom analysis, precautionary or instant medication suggestions and appointment booking, all these in a single application. Further, considering people who cannot write fluently, those with special needs and those in emergency situations, both voice and text input formats are accepted by the chatbot. We are building the website using Flask, which contains Login and registration page, dashboard of website, appointment booking and viewing pages and also the animated chatbot button at the end of every page of the website.

Speech enabled chatbots provide higher level of interactivity and usability. User can either give their input using text or speech and similarly chatbot is able to give its response by either text or voice. In our project, this process of conversion between text and speech is done by using speech_recognition and pyttsx3 python modules.

A. Voice Input by User (Speech to Text):

Using systems inbuilt microphone live audio input can be transcribed using Google's Web Speech API (recognize_google()).By using adjust for ambient noise function we can set the engine to listen to ambient noise for some time period(here 2 seconds) and adjust energy threshold accordingly. If speech Recognizer unable to detect the speech correctly, respective error messages will be given as response.

B. Voice Output by Bot (Text to Speech):

Pyttsx3 is a Text to Speech Conversion Python Library. Using pyttsx3.init() an engine instance will be created for which we can set various properties like voice rate, volume level and also voices (male or female).We can directly pass the text that need to be converted to voice to this engine and output will be voice saying the text accordingly.

User gives a question to interact with the chatbot. Following that, an LSTM model is used to analyse the user query. LSTMs, shown in Fig. 1, are a type of recurrent neural network that, rather than simply passing its result to the next section of the network, performs a series of math tasks to work on its memory. There are four "gates" in an LSTM. They are forget gate, remember gate, learn gate, and output gate.

Step 1: The three information sources enter the LSTM and are directed to the forget or learn entryways. Long term information is shipped off the forget entryway, where some of it gets lost (the irrelated parts). The learn gate receives the short-term information and "E." This gate determines what information will be gathered.

Step 2: Data that goes through the forget entryway (it isn't neglected; failed to remember data stays at the door) and the learn entryway (it is learned) will be shipped off the remember entryway (which makes new long-term memory) and the utilization entryway (which updates momentary memory is the final result).

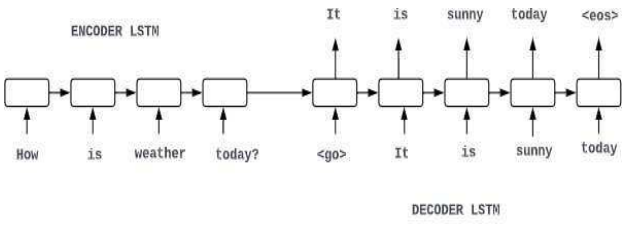

Fig. 1. LSTM architecture

Sequential model is created with 3 layers, First layer has 160 neurons and second layer has 80 neurons. Both first and second layer uses relu activation function. Rectified Linear activation function (ReLU) is a linear function that will yield the info straightforwardly assuming positive any other way it will give yield as nothing. For the last layer, number of neurons will be same as the number of intents of predicted output with a SoftMax activation function. Now the model has been created, Stochastic Gradient Descent optimization technique is used to find the minimum possible cost function. Beginning from an underlying worth, Gradient Descent runs iteratively to track down the idea upsides of the boundaries to track down the minimum possible worth of the given cost function. SGD is preferred as it is easy to implement and efficient.

IV. Implementation

BOTAID provides multiple features which makes it a user friendly web application. We have used flask for the frontend development and Google's speech to text API to enable users to give voice queries and convert text replies of bot to voice.

A. User Authentication

For any user to access the website, they must login first. If user doesn't have login account, they can register themselves first and the data will be stored into mongo collection. For registration, user must specify their username, email and can set any password.

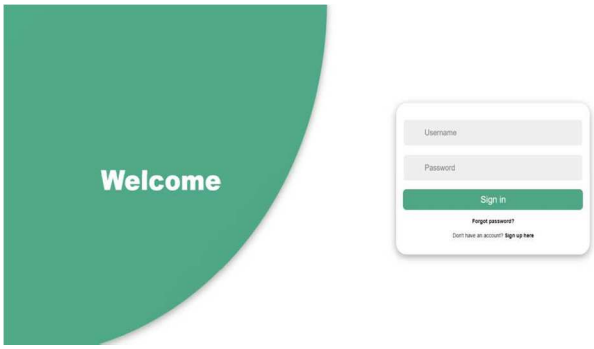

Fig. 2. Authentication webpage

In order to login user must enter their username and password as shown in Fig. 2, the details are then verified using mongo queries and verified users can access application. After successful login, session for that specific user will be created. Session can be used to store user's data across multiple pages of the application.

B. Chatbot

The chatbot is the most important feature of our application (Fig. 3).The aim of this chatbot is resolve the user queries in the best way possible. We have used deep neural network techniques like LSTM to classify user query and generate perfect response. The JSON dataset is sent as input to the model, which contains tags and responses that matches to particular pattern. We used NLTK to pre-process the data. To resolve ambiguity, we'll either capitalize or lowercase the user input question. Tokenization: It is the method of breaking a given word into smaller words called 'tokens'. The pre-processing of a large text in NLP starts from Tokenization level. It can be done at various levels like words, character and sub word level. We have used NLTK tokenization, which is the opensource python library for NLP, it contains various levels of tokenization based on user preference like word_toenize, sent_tokenize,Treebank Word tokenizer..etc.

Bag of Words: It is an important technique in modelling the text to structured data, as Machine Learning models give better output for structured data rather than unstructured data. Using Bag of Words, a text will be converted into its equivalent vector of numbers. We create a bag of words with value 1 if word match is found in the pattern that is currently using.

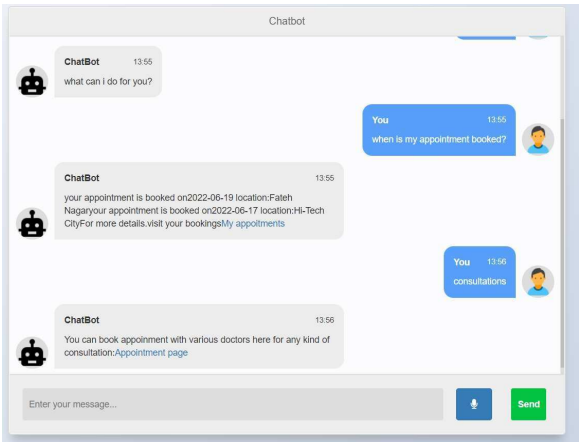

Fig. 3. Chatbot

C. Appointment Booking

This feature provides an easy way for user to book their appointment. It is accessible by clicking the "Book an Appointment" card on the dashboard, as shown in Fig. 4. Whenever user requests for an appointment booking or view their booked appointments, chatbot will provide navigation links to those respective parts of the website, which when clicked page will be opened in new tab.

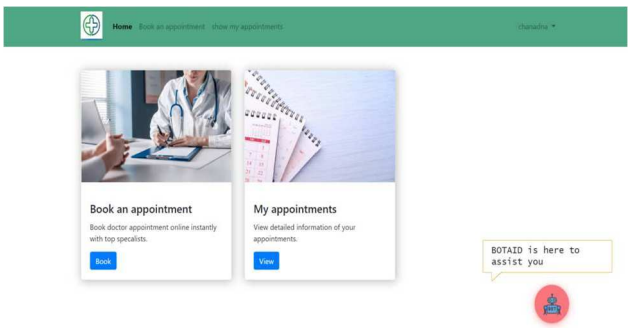

Fig. 4. Dashboard

D. View Booked Appointments

This feature is used to view the appointments booked by that particular logged in user. User's data is protected by displaying only that user's data, not the others. This is implemented using flask session.

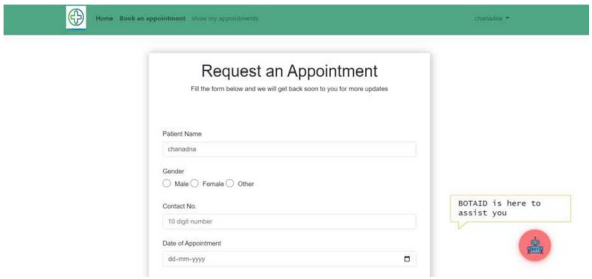

Fig. 5. Appointment page

A form, shown in Fig. 5, needs to be filled out to book the appointment. It contains following fields Patient name, gender, Contact number, appointment date, hospital location and department. After filling all the details and clicking submit, a new appointment record will be stored under users name in the database.

V. Results

The main purpose of this project is to create a chatbot for hospital that will answer queries raised about disease diagnosis, simpler appointment booking, medicine and food recommendations. Therefore, our chatbot responds to the queries related to all of them. Typically, this chatbot is enabled with speech input which enables simpler and easy conversations between bot and user.

By using deep neural networks for chatbot, we were able to achieve accurate results for single word query as well. Most of the users are handy towards the short words rather than using long sentences for queries. There are few hyperlinks linked in the dataset so that for more information about the particular query they can easily click the hyperlink and the website would be displayed as shown in the Fig. 3.

Plotting the loss curve (Fig. 6) shows that the training loss of our model is around 15% and the validation loss is about 16%. The losses will be lower as the epochs and datasets increase, and the model's performance will improve.

The accuracy curve (Fig. 7) shows the number of correct predictions made by our chatbot. The training accuracy is at about 98%, and the validation accuracy is approximately 87%.

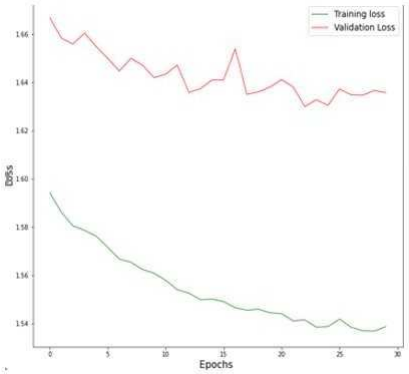

Fig. 6. Loss curve

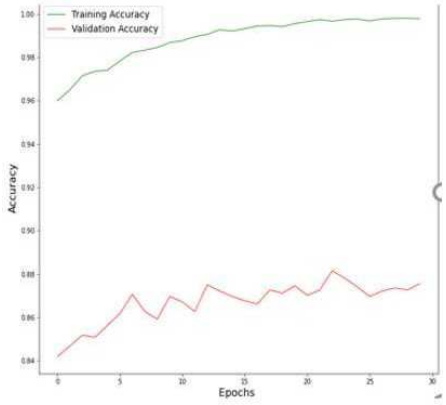

Fig. 7. Accuracy curve

For our model we have got validation accuracy to be around 87% and validation loss 16% for 30 epochs.

VI. Conclusion

Our hospital management system chatbot's main goal is to automate repetitive tasks in a user-friendly manner, allowing hospital employees to focus on important tasks and also enabling fast response for customers instead of waiting for an employee to solve their queries because they can interact with the bot at any time. Enabling speech recognition in our chatbot also facilitates a simple and quick conversation. The user-interactive UI makes it easier to navigate the website.

We put our application chatbot through its paces by experimenting with a number of various profiles. The results were satisfactory.

VII. Future Scope

There can always be a scope of improvement for any project. Currently, disease diagnosis, appointment booking, viewing user appointment details, and test costs are available. More refined data will provide users with more options for resolving their queries. To make the application more accessible to users, it can be integrated with any hospital website.

Additionally, we can include features like queries using image-based queries and can receive SMS alerts to remind us of the appointment bookings.

References

[1] M. Mittal, B. Gopi, D. Singh, T. Nagarwal, P. Yadav, "Web-based chatbot for frequently asked queries (FAQ) in hospitals", Journal of Taibah University Medical Sciences, vol. 16, no. 5, pp. 740-746, 2021.

[2] R. B. Mathew, S. Varghese, S. E. Joy and S. S. Alex, "Chatbot for disease prediction and treatment recommendation using machine learning", 3rd Int. Conference on Trends in Electronics and Informatics, pp. 851-856, 2019.

[3] L. Athota, V. K. Shukla, N. Pandey and A. Rana, "Chatbot for healthcare system using artificial intelligence", 8th Int. Conference on Reliability, Infocom Technologies and Optimization, pp. 619-622, 2020.

[4] D. S. Rao, K. L. Srikanth, J. Noshitha P. Pratyusha, M. Sucharitha, M. Tejaswini and T. Ashwini, "Development of artificial intelligence based chatbot using deep neural network", In: P. Raju and P. K. Shukla (eds), SCRS conference proceedings on intelligent systems, pp.143-151, 2021.

[5] J. Weizenbaum, “ELIZA- A computer program for the study of natural language communication between man and machine”, CACM, vol. 9, no. 7, pp. 36-43, 1996.

[6] H. Pawar, P. Prabhu, A. Yadav, V. Mendonca and Joyce Lemos, “College enquiry chatbot using knowledge in database”, Int. J. for Res. in Appl. Sci. Eng. Techno., vol. 6, no. 4, pp. 2494- 2496, 2018

[7] N. Thakur, A. Hiwrale, S. Selote, A. Shinde and N. Mahakalkar, “Artificially intelligent chatbot”, Universal Research Reports, vol. 4 , no. 6, pp. 43-47, 2017.

[8] B. S. Bani and A. P. Singh, “College enquiry chatbot using A.L.I.C.E (artificial linguistic internet computer entity)”, Int. J. New Techno. Res., vol. 3, pp. 164-65, 2017.

[9] R. P. Schumaker and H. Chen, “Leveraging question answer technology to address terrorism”, Inquiry,Decision Support Systems, vol. 43, pp. 1419-1430, 2007.

[10] I. Ahmed and S. Singh, “AIML based voice-enabled artificial intelligent chatterbot”, Int. J. of u- and eService, Sci. Techno., vol. 8, no. 2, pp.375-384, 2015.

[11] M. Awad and L. Khan, “Web navigation prediction using multiple evidence combination and domain knowledge”, IEEE Trans. on Syst., Man Cybern., vol. 37, pp. 1054-1062, 2007.