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Chatbot for Hospital Management System

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***Abstract*: The healthcare sector represents one of the most significant segments of the economy. This sector offers medical services and goods to everyone. A reliable healthcare system ensures a strong economy by increasing life expectancy, contributing to national growth, and reducing the burden on families. The purpose of this project is to implement a proper healthcare management system integrating all the basic functionalities powered by an Artificial intelligence (AI) chatbot that is capable of having a very organic conversation with the user and solving their queries using a knowledge base. The knowledge base has real-time data collected in a JSON format which is pre-processed to make it ready for further processing. The bag of words model is used for further pre-processing. Further, the proposed methodology uses Deep Neural Networks to implement the chatbot which has speech recognition capabilities. 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 and any immediate measures to be taken. In addition, it provides information regarding diagnostics beforehand.**

***Keywords*: Chatbot, Appointments, Diagnosis, NLP, Long Short Term Memory (LSTM), Recurrent Neural Networks (RNN).**

1. Introduction

An AI chatbot is a computer program that simulates human communication. It is a piece of software that interacts with a human through written language. It is often embedded in web pages or other digital applications to answer customer inquiries without the need for human agents, thus providing affordable effortless customer service. Chatbots based on Machine Learning make an AI chatbot that is very capable of having an organic conversation with the user and answering their queries. Chatbots make use of the data given to them and using different training algorithms they can answer the queries in the best way possible.

In our proposed system we create a conversational chatbot that is integrated into a hospital website.

It is trained using Machine Learning algorithms and acts as a very efficient interface between the user and the application. There is no predefined format for the users to ask their queries in, the chatbot manages to answer the query in the best possible way. Users have the flexibility to raise a query both in text and speech format.

Fig. 1. A chatbot- an artificial human

With this chatbot, users have access to 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 book appointments, and identify the problem by specifying symptoms to try to know about it beforehand, doing this they can take any required precautionary measures and book an appointment with the doctor as soon as possible.

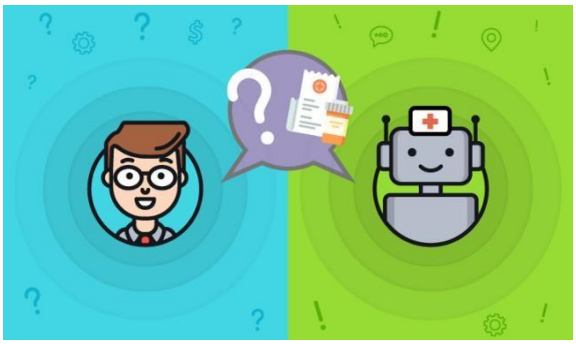
Fig. 2. Technology for Healthcare Queries

2. 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 the paper by Mamta Mittal [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 a cost-minimization

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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 modeling is combined with statistical, deep learning models and machine learning in NLP. These technologies work together to allow computers to analyze 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.

In the paper by Rohit Binu Mathew [2], KNN (K-nearest neighbor algorithm) and NLP (Natural Language Processing) algorithms are used to create the chatbot. The K-Nearest neighbor 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.

In the paper by Harsh Mendapara [3], the backend of the chatbot is written in Python, while the user interface is created using HTML, CSS, and JavaScript. Chatterbot, a natural processing library, is used to communicate between the user and the system. Text analysis is used to apply natural language processing. The application is hosted on a localhost server, which responds to user inquiries with relevant information. On the localhost server, the healthcare assistant's frontend interface is presented, and it is ready to address patient symptoms based on a certain ailment. The health assistant will collect certain personal information from the user at first, which will be saved in the database. User queries are entered into illnesses such as headaches, coughs, and colds. A separate data file is prepared for a doctor's appointment. The chatbot will next ask the user a question in which the user is expected to address health-related issues. If the patient has a high temperature, high bp (blood pressure) or low bp then the chatbot will prescribe the necessary medicine.

In the paper by Siddhi Pardeshi [4], Long Short-Term Memory (LSTM), Natural Language Processing (NLP), Hybrid Emotion Inference Model (HEIM), Pattern Matching Algorithm and Naive Bayes Algorithm are some of the chatbot design techniques covered. Natural language processing allows machines to take in input, break it down, retrieve its meaning, determine suitable action, and respond to users in natural language. Long Short-Term Memory (LSTM) is a Artificial Recurrent Neural Network (RNN). LSTMs are useful not just for processing single data inputs such as photos, but also for processing full sequences of data such as voice or video. The LSTM algorithm's primary tasks are handwriting identification and speech recognition. The most popularly used algorithm in chatbots is pattern matching algorithm. This Algorithm is basically a database that contains questions and corresponding answers. Patterns are like the names to the questions, whereas templates identify responses/answers. The response to this query is made up of Artificial Intelligence Mark-up Language (AIML) tags. Patterns (questions) and templates (answers) are stored in a tree structure. Questions are on the branches, and responses are at the nodes, thus anytime a user asks a question, the query is first searched for an answer term by term, and then the specific answer is fetched from the node. Another most popular algorithm used in chatbots is Naive Bayes. Tokenization comes first in this process, followed by stemming. Tokenization is the process of breaking down a phrase into individual words called tokens. The stems are then added to each token. For example, the sentence "it is a giant lion" is tokenized and then stemmed as "it" ,"is" , "a", ”giant” and "lion". The following step is to provide training data. This information is saved in the form of lists or dictionaries, with class and sentence as properties in the dictionary.

In the paper by Lekha Athota [5], 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 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.

In the paper by Dammavalam Srinivasa Rao [6], 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 preprocessing 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.

3. Existing System

In all the existing systems, the scope is divided and they provide very few features at a time. Few chatbots only provide appointment booking functionality only and also may not include voice inputs from the users. Some bots provide disease diagnosis but can’t provide medication and navigation through

a complex hospital website. There are smaller number of chatbots integrated to hospital website that provides all the necessary contents and features.

4. Proposed System

The proposed system focuses on integrating all basic features in one place in an application and powering it with an AI chat bot further adds new functionalities like easy navigation, access to data on 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. After that, a model developed with LSTM analyses the user query. LSTMs are a kind of recurrent neural network that, as opposed to just passing its result into the following section of the network, plays out a progression 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).

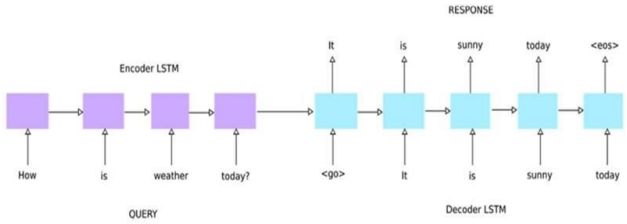

Fig. 3. LSTM model

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 ideal 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.

The training data is fit to the model and using 1000 epochs best accuracy of 94.85 and minimum loss of 8.15 is obtained.

5. Implementation

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

The features which of botaid are:

- User Authentication
- Chatbot
- Appointment Booking
- View booked appointments

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.

In order to login user must enter their username and password, 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.

Chatbot: Chatbot is the major feature of our application. 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 preprocess the data. To resolve ambiguity, we'll either

capitalize or lowercase the user input question.

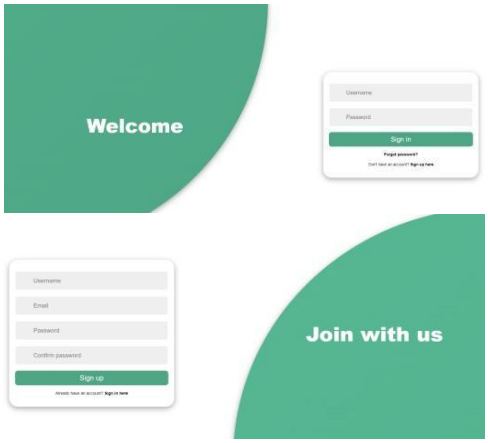

Fig. 4. Login and registration webpage

Tokenization: It is the method of breaking a given word into smaller words called 'tokens'. The preprocessing 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.

Lemmatization: It is the process of reducing a given word into its canonical form such that root word is called as 'lemma'. The technique involves gathering the curved pieces of a word in a manner that can be perceived as a solitary component. This is similar to stemming yet the root words have meaning. For example, Lemmatization extracts the base form of 'studies' to 'study' that has same meaning whereas, Stemming will remove 'es' part and converts to 'studi' which results in cutting of the ends of word which doesn't actually gives any meaning.

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.

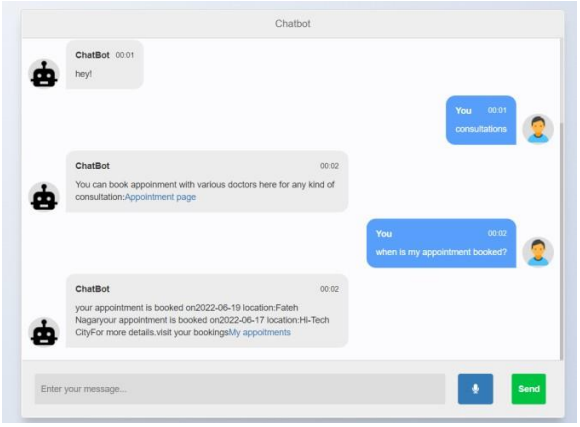

Fig. 5. Chatbot

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.

Appointment Booking: This feature provides an easy way for user to book their appointment. It can be accessed by clicking the Book an appointment card on the dashboard.

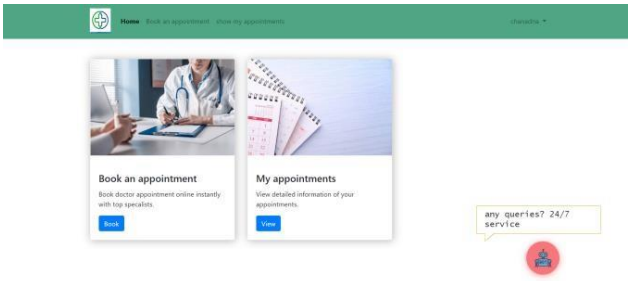

Fig. 6. Dashboard

A form needs to be filled 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 user's name in the database.

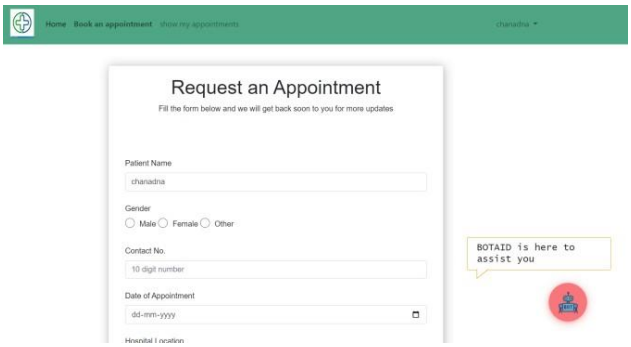

Fig. 7. Appointment page

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.

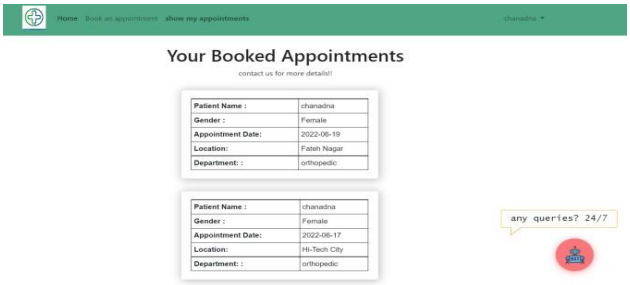

Fig. 8. View appointments page

6. Future Scope

There can always be a scope of improvement for any project. In this we can incorporate more department specific data to make the chatbot more diverse, as of now disease diagnosis, appointment booking, viewing user appointment details and test costs are included. More refined data will give more scope for

user to resolve their queries. The application can be integrated with any hospital website to make it more reachable for users.

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

7. Conclusion

The main objective of our hospital management system chatbot is to automate repeated tasks in a user-friendly manner such that it will provide hospital employees to focus on important tasks and also to enable fast response for customer instead of waiting for employee to solve their queries as user can interact with bot anytime. Enabling Speech recognition in our chatbot also helps customers to have a simple and fast conversation. The user interactive UI provides better navigation through the website.

We have tested our application by trying various kinds of profiles. The results were satisfactory.

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