Disease Detection Using RASA Chatbot

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***Abstract* - Chatbots, or conversational AI(Artificial Intelligence) Interfaces, provide individuals a new way to interact with computer systems. Chatbots allow users to have conversations with the system by asking questions in the way that they would with another human beings. The current adoption rate of chatbots on computer chat platforms is very high. Such robots use artificial intelligence to understand human input and respond accordingly. The core technology for the rise of chatbots is "Natural language processing" (NLP). The recent advancements in NLP have allowed chatbots to be more receptive than ever. Today, humans can interact with the chatbot systems anytime, anywhere. Chatbots can perform predictive tasks (especially in the medical field), which is now possible with advances in artificial intelligence and data mining technology. Healthcare, agriculture and education are important areas that need the most attention. In today's world, with the change in lifestyle and the current pandemic, illnesses have increased in the general population. As a result, the need for hospitals and doctors have increased substantially. Patients have to spend their time waiting to be taken care of by the doctors. Also, doctors have an immense amount of workload with the amount of visits they have. Thus, the future of healthcare depends on the ability of care providers to perform accurate remote diagnosis. This can be done by collecting data remotely, and by using artificial intelligence to analyse data to improve business and health outcomes. In this paper we analysed datasets to accurately detect diseases with classification techniques such as SVM Classifier and Naïve Bayes Classifier.**

The tools used are RASA, machine learning classification algorithms, data extraction etc.

Keywords: Artificial Intelligence, accurate remote diagnosis, RASA, Natural language processing.

I. INRODUCTION

A healthy body is one of the greatest gifts we can have. Every one of us aspires to have a healthy physique and a better quality of life. But, humans have been working so hard and constantly over the past few years that they have neglected to prioritise their health on a daily basis. In the long run, this issue puts people's quality of life in jeopardy. We can now give health care services to individuals at their convenience at cheap prices all thanks to Artificial Intelligence.

A chatbot is an artificial intelligence-based software tool that may mimic a discussion (or a chat) with a user in human language via messaging apps, websites etc. A chatbot is frequently regarded as one of the most advanced, effective and promising forms of human-machine interaction. The heart and soul of AI-powered chatbots is natural NLP. The advanced NLP algorithms can understand, deduce, and identify the expression of incoming text by the client and can respond accordingly.

People avoid going to the hospital for minor issues. In the future, these little issues will turn into serious diseases. The early detection of serious diseases is a great challenge. Going to the hospital is a time consuming process and is not easily affordable.

The medical chatbot overcomes all of these issues; the main benefit of a chatbot is that it is free, easily available and convenient to use, meaning that a user can use it at at any time. As a result, it is a significant invention that primarily saves time spent consulting specialised doctors. It also responsible to provides people with more information about their health status and preventative steps to help them stay healthy indefinitely.

Various data mining algorithms are available, and when compared using medical datasets for performance and accuracy, studies showed that The Decision Tree, Nave Bayes, Neural Networks, KNN, SVM algorithms had the ability to explore hidden pattern within the data. As abundance of medical data and information rich records are available for these algorithms to feed on a significant impact can be made in this industry.

II. LITERATURE SURVEY

Chatbots are Computer programs equipped for doing regular discussions. Artificial intelligence is changing organizations and chatbots controlled by AI are turning into an attainable client assistance channel and diminishes labor. Some utilization refined NLU frameworks, yet numerous less complex ones examine for keywords inside the given information, then, at that point, pull an answer with the most coordinating with catchphrases/designs from a data set.

A paper by Sherwin Fernandes et.al [1] on doctor chatbot used classification models like SVM and Naïve Bayers, KNN and Decision Tree an compared their accuracy on heart disease dataset and found out SVM had the highest accuracy. A paper by Aishwarya Kedar et.al [2] used PRISMA checklist methodology as the model of systematic review. They chose this method because PRISMA is the recognized standard for reporting evidence in systematic reviews and meta-analyses.[3] A Chatbot for Psychiatric Counselling in Mental Healthcare used NLU, Word Embedding Algorithms, Framework for Emotional Recognition. In this multiple-modal approach is used for defining an Emotional Expressions to Categorize and Collect Training Data for Emotion Recognition, Emotion Recognition, and Inference [4]. MedBot used Pattern matching algorithm, NLU, Dialogflow API and DoctorMe App's datasets. Using provided API this chatbot was easily implemented in Facebook, Hangout etc.[5]

In a self-diagnosing healthcare chatbot by S. Anil Kumar et.al [6] A linear design was used that went from symptom extraction to symptom mapping, identifying the corresponding symptom, determining whether it was a major or minor disease, referring the patient to a doctor, extracting the doctor's information from the database, and identifying the user using the login information from the database. With no

need to wait for a medical expert, travel, or even lose business days, online doctor consultation overcomes geographic barriers and provides professional understanding for the patient with their problem. . There are some ways to achieve weight loss success: increasing exercise, reducing food intake, self-monitoring of diet, exercise as well as weight, self-regulation.[7]

In the paper by Lekha Athota at.al [8] the quire of the user is answered using an expert system if the answer is not available in the database. The space specialists additionally should enlist themselves by giving different subtleties. The information of the chatbot put away in the data set as example format. Here SQL is used for dealing with the dataset.

Here the chatbot is made for the client assistance that capacities as general wellbeing administration. The application utilizes Ngram, TF-IDF and cosine closeness. The information base is made for putting away the Q & A. The application unmistakably shows extricated the catchphrase from the inquiry and by utilizing unigram, bigram, and trigram which helps in quick replying.[9]

According to Du Preez et.al [10] in which a voice acknowledgment talk bot is created. The inquiries posed to the bot are not perceived are further handled utilizing the expert-system of third parties. The webbots are made as web-companions dependent on text, a client performer. In the event that the program isn't just text-based, yet in addition voice-based prepared, they focused on the improved framework here. Here, a two-section interaction of catching and examining an information signal is needed for voice acknowledgment. Acknowledgment of information from the server reaction and handling of data. The server utilized here is a discovery approach in view of SOAP. Utilizing a specialist framework makes it conceivable to work on limitless and independent knowledge.

Mrs. Asha Rani et.al [11] used a approach in which the User will send queries and chatbot will give its reaction with proper message. For the smooth exceeding everyone's expectations customized predefined way with some conceivable inquiry and answers that can be posed by the client. This text/visit handling is finished utilizing Natural Language Processing. The possibility of the paper is a self-analysis clinical chatbot the utilization of computerized reasoning through [12] is to foster a machine the utilization of AI so one can assist clients to avoid meeting with a doctor. It is made to distinguish the disease of a client and convey significant subtleties of a sickness.

The clinical consideration chatbots working depends upon Herbal language Processing that works with clients to set up their bother roughly the wellness. inquiry is dispatched to chatbot and the buyer gets related arrangement which is shown on web app [13]. One significant undertaking done by NLP is tokenization. The key usefulness of tokenization is to change over the text got from the client to tokens. Tokenization happens in such a manner that various words will be changed over to various tokens.[14]. It proposes the possibility of chatbot as a virtual collaborator or as a shrewd specialist that can finish undertakings like giving legitimate reactions to inquiries from clients, controlling gadgets, giving courses during driving and so forth.[16]

In M. Mandzuka et al. [17], the creators exhibited four state of the art assessment measurements prior to applying the most generally utilized text based arrangement methods like Neural Network, Random Forests, Bayesian Network, and SVM. As per their exploration concentrate on SVM works best much of the time for include determination. The individuals from this review [18] utilized examination records in the text arrangement to assess the reason for death. They incorporated toxicology results from seven particular reasons for death, ran preprocessing, dimensionality decrease, and component designing on them, and afterward made a bit work with 20 highlights for each audit.

A paper by Vikas Kamra et.al [19] proposed a model that accepting client's manifestations as information as a sound record and anticipated the client's probability of creating mental problems dependent on that data. Not really settled whether an individual has OCD, BPD, or Schizophrenia, just as its exactness.

The proposed thought of the paper "An original methodology for clinical help utilizing prepared chatbot" by Divya Madhu et.al [20] is to design a model using modernized thinking eat urges the customer to see the ensured therapy for affliction. There are a huge load of meds available for a particular sickness and it's not possible for anyone to unequivocally suggest the fitting treatment and which is the best partner for that disease. In this proposed, artificial mental ability accepts a critical part by giving a record of available medications

III. PROPOSED METHODOLOGY

The purpose of this chatbot is to maintain human-like interaction with the user along with predicting the correct disease according to the user's symptoms. NLP techniques along with machine learning algorithms allow us to create such a conversational AI. While our main focus is to give a prediction about the disease the user might have based on their symptoms, creating an interactive medical bot which can hold a conversation with the user and gives appropriate responses and accurate information is also a feature of a good and reliable chatbot. For all of this we need to have the correct algorithms as well as a good data set.

Architecture:

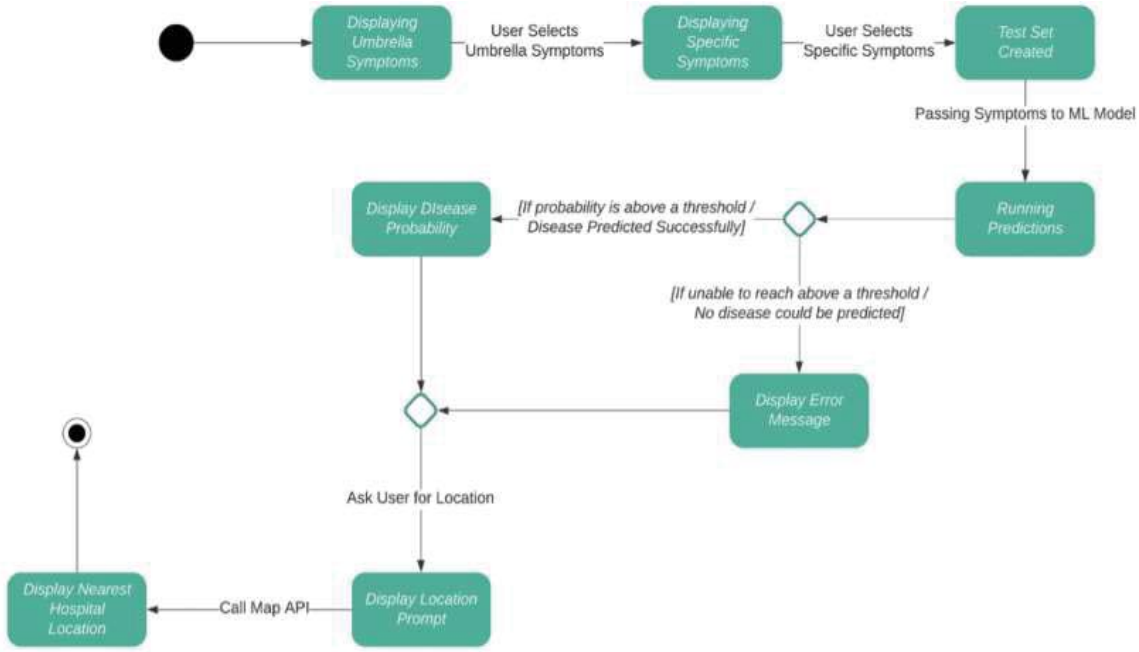

Fig. 1 State Diagram Chart

The chatbot will prompt the user for their symptoms and as the questions progress, the symptoms will become more specific. Once all the symptoms of the user are entered, the symptoms are converted into a vector. This vector is the test set which is then passed into the Machine Learning classification model. The model will output a disease which the model predicts.

After the disease is detected, the user may opt to book an appointment with a doctor. To do so, the bot will prompt for the user's location and an API call will be made to find all the doctors in that area which specialize in consulting for the disease which was diagnosed.

A. Disease Detection

1) Data Collection and Analysis

We searched through many different datasets consisting of diseases and symptoms. We decided to analyze 2 different types of datasets, i.e., disease specific dataset and common disease dataset and their symptoms.

Heart disease Dataset

This dataset was taken from Kaggle. It consists of 15 columns, in which 14 represent the different attributes of the heart disease and the last columns represents weather the heart disease is present or not.

age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target
63	1	3	145	233	1	0	150	0	2.3	0	0	1	1
37	1	2	130	250	0	1	187	0	3.5	0	0	2	1
41	0	1	130	204	0	0	172	0	1.4	2	0	2	1
56	1	1	120	236	0	1	178	0	0.8	2	0	2	1
57	0	0	120	354	0	1	163	1	0.6	2	0	2	1
57	1	0	140	192	0	1	148	0	0.4	1	0	1	1
56	0	1	140	294	0	0	153	0	1.3	1	0	2	1
44	1	1	120	263	0	1	173	0	0	2	0	3	1
52	1	2	172	199	1	1	162	0	0.5	2	0	3	1

Fig. 2 Heart Disease Data Set

Analysis of Heart Disease Data Set:

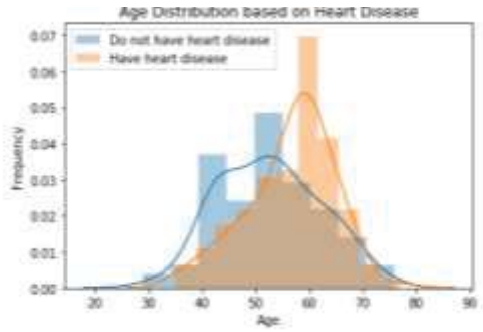

Fig. 3 Age Distribution

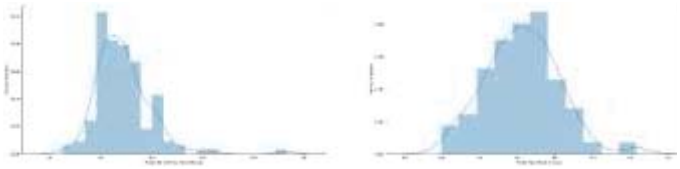

Fig. 4 Cholesterol Distribution

Disease-Symptom Dataset

The data set we have taken was provided by Columbia University. It represents disease-symptom associations based on discharge summaries of patients in New York Hospital Presbyterian admitted during 2004. The data set consists of 150 different diseases with 349 unique symptoms.

	Disease	Count of Disease Occurrence	Sympto
0	UMLS:C0020538_hypertensive disease	3363.0	UMLS:C0008031_pain che
1	NaN	NaN	UMLS:C0392680_shortness of brea
2	NaN	NaN	UMLS:C0012833_dizzine
3	NaN	NaN	UMLS:C0004093_asther
4	NaN	NaN	UMLS:C0085639_f

Fig. 5 Disease-Symptom Data Set

Analysis of Disease-Symptom Data Set:

```
No. of diseases: 149    No. of symptoms 397

Diseases:                          Symptoms:

hypertensive disease               pain chest
diabetes                           shortness of breath
depression mental                  dizziness
depressive disorder                asthenia
coronary arteriosclerosis          fall
coronary heart disease             syncope
pneumonia                          vertigo
failure heart congestive           sweat
accident cerebrovascular           palpitation
asthma                             nausea
myocardial infarction              angina pectoris
hypercholesterolemia               pressure chest
infection                          polyuria
infection urinary tract
```

Fig. 6 Disease and Symptom Count

2) 3.1.2. ALGORITHMS USED

In both heart disease dataset as well as disease-symptom dataset, the data was of the same type, i.e., categorical data. Categorical Data requires classification machine learning algorithms.

SVM Classifier: SVM stands for Support Vector Machine, which is a supervised Machine Learning algorithm which fulfills the purpose of both classification and regression challenges. The rules generated by this algorithm will be used further in Hybrid rule-based induction.

```
svc

classification_report :
              precision    recall  f1-score   support

           1       0.71      0.90      0.79        30
           2       0.81      0.54      0.65        24

    accuracy                           0.74        54
   macro avg       0.76      0.72      0.72        54
weighted avg       0.76      0.74      0.73        54


confusion_matrix :
[[27  3]
 [11 13]]
```

Fig. 7 SVM Classification Analysis

Ada Boost Classifier: It is also known as Adaptive Boosting. The main concept in this classifier is to allot weights of the classifiers and guarantee precise predictions of uncertain observations by training the data sample in each iteration.

```
AdaBoostClassifier

classification_report :
              precision    recall  f1-score   support

           1       0.75      0.80      0.77        30
           2       0.73      0.67      0.70        24

    accuracy                           0.74        54
   macro avg       0.74      0.73      0.73        54
weighted avg       0.74      0.74      0.74        54


confusion_matrix :
[[24  6]
 [ 8 16]]
```

Fig. 8 AdaBoost Classification Analysis

Gradient Boosting Classifier:

In the modern-day world the most important aspect of a Machine learning model is to be accurate, for this they need to use Ensemble Techniques. One such ensemble technique is Gradient Boosting. In gradient boosting techniques we use many weaker models iteratively and learn from them and try to build strong model, when we use this technique on Classifier model it is termed as Gradient Boosting classifier.

```
GradientBoostingClassifier

classification_report :
              precision    recall  f1-score   support

           1       0.79      0.73      0.76        30
           2       0.69      0.75      0.72        24

    accuracy                           0.74        54
   macro avg       0.74      0.74      0.74        54
weighted avg       0.74      0.74      0.74        54


confusion_matrix :
[[22  8]
 [ 6 18]]
```

Fig. 9 Gradient Boosting Classification Analysis

Random Forest Classifier: Random forests, also known as random decision forests, are an ensemble learning approach for classification, regression, and other problems that works by training a large number of decision trees.

```
RandomForestClassifier

classification_report :
              precision    recall  f1-score   support

           1       0.76      0.73      0.75        30
           2       0.68      0.71      0.69        24

    accuracy                           0.72        54
   macro avg       0.72      0.72      0.72        54
weighted avg       0.72      0.72      0.72        54


confusion_matrix :
[[22  8]
 [ 7 17]]
```

Fig. 10 Random Forest Classification Analysis

Decision Tree Classifier:

```
accuracy = decision_tree.score(X_train, y_train)
print('Accuracy of Naive Bayes: ', accuracy)
```

```
Accuracy of Naive Bayes:  0.912621359223301
```

Fig. 11 Fig. 10 Decision Tree Classification Analysis

Multinomial Naïve Bayes Classifier:

This classifier based on Bayesian approach which is famous in NLP. The algorithm gives a tag to the text and later the likeliness of the tag is calculated for the given text and the tag with the greatest chance is given as output.

This is very simple to use and it can take in huge amount of data, therefore is very good to use in real time applications.

```
accuracy = nb.score(X_train,y_train)
print('Accuracy of Naive Bayes: ', accuracy)
```

```
Accuracy of Naive Bayes:  0.9159663865546218
```

Fig. 12 Multinomial Naïve Bayes Classification Analysis

For the heart disease dataset, Support Vector Classifier gave the best accuracy out of the 4 algorithms we used.

For the Disease-Symptom dataset, Multinomial Naïve Bayes Classifier gave a higher accuracy than that of Decision Tree Classifier.

B. Booking A Doctor's Appointment

A dataset consisting of 12 different doctors based on their specializations has been taken by us. The data set consists of the name of the doctor, specialization, timings, days and contact number.

Doctorname	Specialization	Weekly Days	Timings	Contact Number
Dr.G.Gomathi	General Doctor	Monday to Saturday	8:00 A.M to 4.00 P.M	9841999544
Dr.Prithiviraj	ENT Specialist	Monday	9:30 A.M to 10:30 P.M	9444772224
M.N.Eye Hospital	eyecheckup	1st & 3rd Week Monday	9:00 A.M to 1.00 P.M	7358793694
Dr.Ponnudurai	psychiatrist	Tuesday	11:30 A.M to 1:00 P.M	9840013174
Dr.Saradhamani	gynecologist	Tuesday	2:00 P.M to 3:00 P.M	9003032472
Dr.Ramkumar	thyroid specialist	1st & 3rd Week Tuesday	11:30 A.M to 12:30 P.M	9150373630
Dr.Mahalingam	dentist	Wednesday	2:00 P.M to 3:00 P.M	9841126616
Dr.Thulasiraman	ortho specialist	Wednesday & Saturday	11:00 A.M to 1:00 P.M	9840449631
Dr.Selvakumar	diabetologist	Thurday	2:00 P.M to 3:00 P.M	9444414253
Dr.Chandrasekar	gastrologist	2nd & 4th Week Thursday	3:00 P.M to 4:00 P.M	9003261972
Dr.Sundar	neuro surgeon	Friday	12:00 P.M to 1:00 P.M	9843086959
Dr.T.V. Ramesh	skin specialist	Thursday	4:00 P.M to 5:00 P.M	9444631363

Fig. 13 Doctor Data Set

C. Medical Library

After the chatbot outputs the disease prediction of the user, the user will have follow-up questions. The user may ask about symptoms, treatments, doctors, and all types of information specific to the disease. The user might also just want to know about a disease not related to their illness. Creating a database which consists of all the information about a large number of diseases which are very common will help the chatbot to resolve more user queries and allow it to be more useful.

Data of the diseases will be scraped from the medical library of 'ada health' and 'Wikipedia' and stored in a database.

D. Human Like Interaction

All chatbot developers have one common feature in mind and that is for their chatbots to mimic a human interaction as close as possible. Developments in the NLP and neural networks have made it possible to apply artificial intelligence in conversational tools. RASA is a tool which allows us to use these advancements to our advantage and create state of the art chatbots.

1) 3.4.1. RASA

Rasa is a powerful open-source framework which works on the principals of artificial intelligence to create industry grade chatbots. Rasa can work with databases, APIs, machine learning models, etc.

We can partition the architecture of rasa into 2 modules

2) 3.4.1.1. RASA NLU

NLU is a subset of NLP, which along with converting text into its semantic parts, also interprets what the user is saying. The Rasa NLU tries to understand the input to find the intents and extract the entities

3) 3.4.1.2. RASA CORE

Rasa core is the dialogue management system. It decides what response or what action needs to be done next.

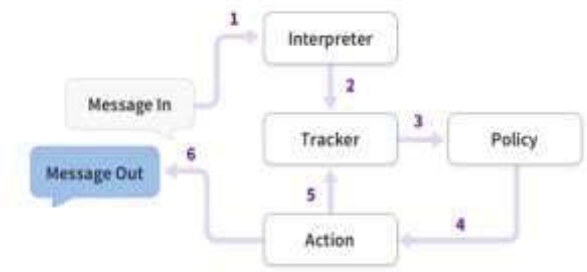

Fig. 14 Rasa Conversational AI Flow

The steps of the Rasa conversation AI are:

1. User input is received and forwarded to the interpreter which converts the text into entities and intents which are discovered by Rasa NLU.
2. The Tracker objects maintains the current state of the conversation.
3. The current state is passed to the policy.
4. The policy decides the chatbot's next move.
5. The tracker then again records the action specified by the policy.
6. The chatbot sends a response based on the action.

IV. CONCLUSION

Artificial Intelligence has started to claim its role into every aspect of our lives. Almost all industries are starting to use or depend on AI. Healthcare is a particular field where Artificial Advancements have not only pushed research forward but also saved people's lives. Creating applications and tools which help in the automation of important tasks, like disease detecting chatbot, can be beneficial to not only patients but also doctors. Conversational AI has also entered our lives with voice assistants like Siri, Google Home and Alexa. Other than voice assistants, chatbots have started to rise in popularity thanks to the advancements in NLP. The main approach of the chat bot system is to detect and display the disease based on the user's symptoms with great accuracy and precision. The ease of using chatbots will ensure that the user does not ignore their smaller symptoms since going to consult a doctor can sometimes become a great hassle. Our aim is to create an easy, convenient and accurate method to get an idea of the user's illness without the visiting a doctor or going endlessly through google.

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