Psychological Assessment Using Chatbot

A major project report submitted in partial fulfillment of the requirement for the awarded degree of

Bachelor of Technology in

Computer Science and Engineering/ Information Technology

Submitted by

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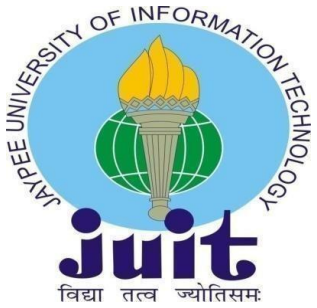
Under the guidance and supervision of

Dr. Nancy Singla



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CERTIFICATE

This is to certify that the work which is being presented in the project report titled **'Psychological Assessment using Chatbot'** in partial fulfillment of the requirements for the award of the degree of B.Tech in Computer Science And Engineering and submitted to the Department of Computer Science And Engineering, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by **"Adhyyan Thakur(201545)", "Yogeshwar Verma (201229)"** during the period from August 2023 to May 2024 under the supervision of **Dr. Nancy Singla**, Assistant Professor (SG), Department of Computer Science and Engineering, Jaypee University of Information Technology, Waknaghat.

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The above statement made is correct to the best of my knowledge

Dr Nancy Singla

Assistant Professor(SG)

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DECLARATION

We hereby declare that the work presented in this report entitled **'Psychological Assessment using chatbot'** in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science & Engineering** submitted in the Department of Computer Science & Engineering and Information Technology, Jaypee University of Information Technology, Waknaghat is an authentic record of our own work carried out over a period from August 2023 to May 2024 under the supervision of **Dr. Nancy Singla** (Assistant Professor (SG), Department of Computer Science & Engineering and Information Technology).

The matter embodied in the report has not been submitted for the award of any other degree or diploma.

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This is to certify that the above statement made by the candidate is true to the best of my knowledge.

Dr Nancy Singla

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We would like to express our heartiest gratitude to **Dr. Nancy Singla** (Assistant Professor (SG), Department of CSE), for her kind help to finish our project.

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Finally, we must acknowledge with due respect the constant support and patience of our parents.

Mr. Adhyyan Thakur **(201545)**

Mr. Yogeshwar Verma **(201229)**

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LIST OF ABBREVIATIONS

LSTM	Long Short Term Memory
ANN	Artificial Neural Network
MSE	Mean Squared Error
DNN	Deep Neural Network
CNN	Convolutional Neural Network
RNN	Recurrent Neural Network
PTSD	Post-Traumatic Stress Disorder
BA	Behavioural Activation
LR	Logistic Regression
CBT	Cognitive Behavioural Therapy
AI	Artificial Intelligence
NLP	Neural Language Processing
KNN	k-nearest Neighbour
UI	User Interface
API	Application Programming Interface
CMS	Content Management System

ABSTRACT

Depression is a major issue that affects the entire world today. Studies have shown that speaking with a computer is more comfortable than speaking with a person. The goal of this project is to employ chatbots to uplift a sad person. This chatbot that can converse with people in a way that makes them feel better. It develops emotional support by being exposed to an exciting discourse corpus throughout training. Seq2seq, LSTM, TensorFlow, RASA, and other frameworks and libraries have all been used by us. The training of models requires a strong GPU. Such a Chatbot has the advantage of acting as a psychiatrist, reducing the harmful effects of depression, and advancing society.

Deep learning and machine learning techniques are frequently used in the creation of chatbots. Since RNN is thought to be the best option for text-based analysis, various RNN based techniques are applied on this model, including LSTM, Seq2Seq library, and RASA framework. A unique kind of RNN called LSTM is able to learn long-term dependencies. Encoders and decoders made the model developed using the Seq2Seq module. In the form of a hidden state vector, the encoder records the context of the input sequence and passes it to the decoder, which subsequently creates the output sequence.

RASA, an open-source framework for machine learning is used to create chatbots and AI assistants.

CHAPTER 01: INTRODUCTION

1.1 Introduction

Nowadays, messaging between two or more parties has become the most powerful way of communication, this is the basic of a chatbot and that is why chatbots have become more and more famous and many companies are adopting the concept of a chatbot. Cheerbot will be able to assist those suffering from mental illnesses like PTSD [Post-traumatic stress disorder], depression, and anxiety. The purpose of this project is to use chatbots to encourage someone who is depressed. Cheerbot can engage in conversations with users that will make them feel better. By exposing it to an inspiring discourse corpus throughout training, it becomes emotionally supportive. Since this is a computer program. It can skill up and skill down the resources depending on the circumstances, which saves time and money.

This a retrieval-based chatbot with the name "CHEERBOT." In addition to retrieval-based models, generative chatbot models were also generated. The "CHEERBOT" was created using RASA [Receive, Appreciate, Summarize, Ask [1], an opensource machine learning platform for creating contextually based chat and voice AI assistants. Since RNN [Recurrent neural network] is thought to be the best option for text-based analysis, several RNN-based methodologies were applied including LSTM [Long Short Term Memory] and Seq2Seq library. A unique variety of RNN called LSTM is able to learn long-term dependencies. Encoders and decoders made up the model developed using the Seq2Seq module. In the form of a hidden state vector, the encoder records the context of the input sequence and passes it to the decoder, which subsequently creates the output sequence.

A chatbot is a piece of software that offers the user a genuine conversational experience. There are chatbots for closed domains and chatbots for open domains (generative). A chatbot with a closed domain only responds with prewritten words. As the name suggests, a generative chatbot creates a response

Chatbots are of three types [2]:

- Rule Based
- Retrieval Based
- Generative Model

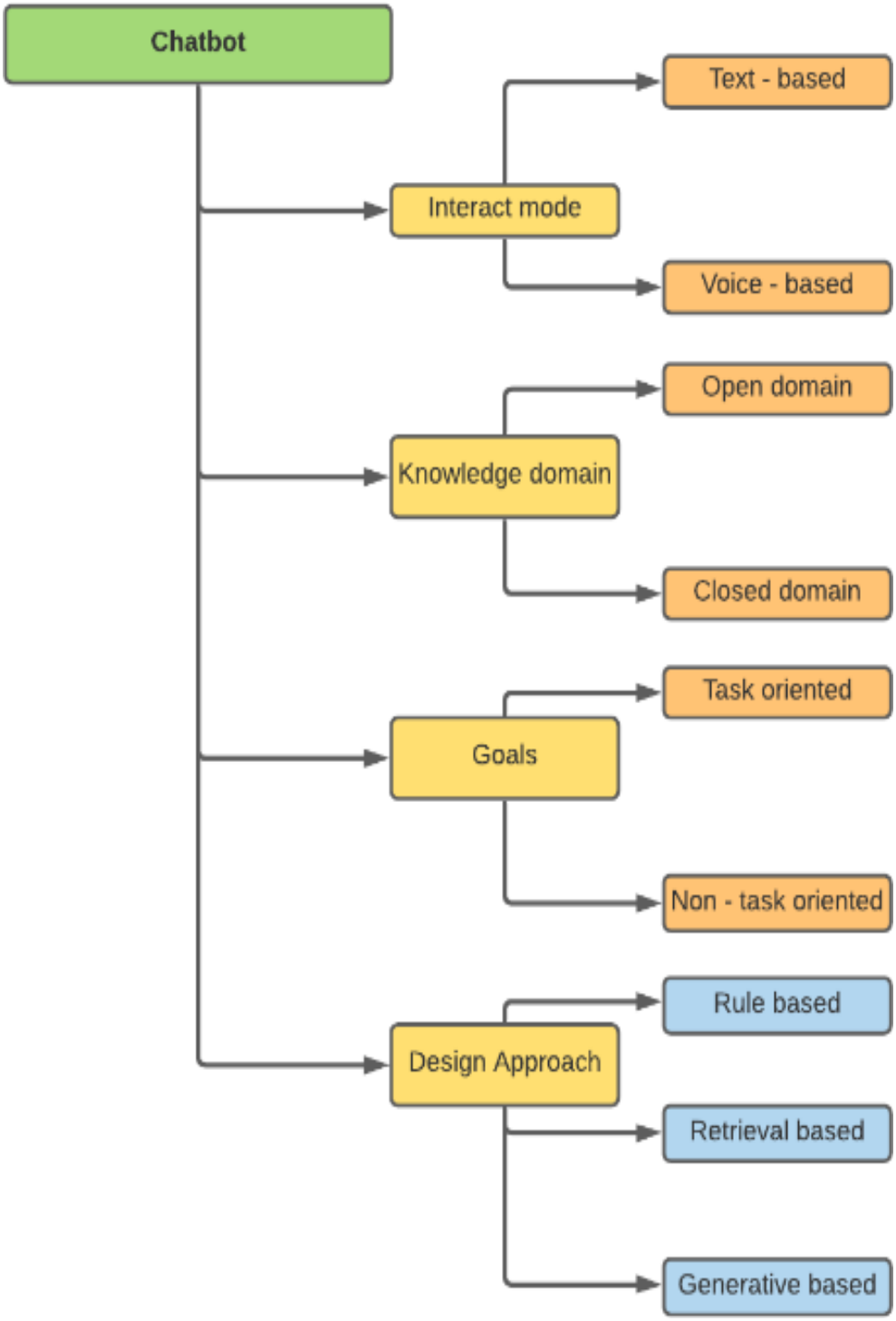


Fig 1.1 Types of Chatbot

Rule-Based Chatbot respond to inquiries in accordance with their training. The name implies that they adhere to a set of norms. The kind of problems the chatbot is familiar with and capable of handling are based on these guidelines. Flowcharts are used by rule- based chatbots to organise discussions. They decide how the chatbot should answer before a customer ever submits a question. Simple and complex rules can both be used by rule- based chatbots. Rule-based chatbots work and work in the settings you've given them.

Retrieval-Based Chatbot in the retrieval based chatbot answers are either manually entered or predicated on a database of previously gathered information. They don't produce fresh texts, just like rule-based chatbots. The responses of Generative Chatbots are not pre-programmed. Instead, they are instructed using a huge library of prior conversations from which they draw their responses to the user. For training, they need a substantial volume of conversational data. For conversational chatbots that the user merely wants to have fun with, generative models are ideal. These types can nearly always provide you with a response. Generative models are used for creation since they begin from scratch. For making chatbots these are the following methods:

- Using frameworks like Microsoft bot, IBM bot, Amazon bot and RASA Framework.
- Using python modules like Chatterbot and for generative chatbots python modules like Seq2Seq and LSTM can be used.

Both the above approaches for building our chatbot have been used. For the first approach RASA framework is used and for the second both Seq2Seq and LSTM.

1. Rasa-based Chatbot

Customizable and Extendable: Rasa allows for extensive customization, enabling developers to tailor the bot's behavior and responses to specific needs.

2. Seq2Seq-based Chatbot [3]

Encoder-Decoder Architecture: Utilizes a two-part architecture where the encoder processes the input sequence and the decoder generates the output sequence.

Attention Mechanism: Enhances the model's ability to focus on specific parts of the input when generating responses, improving the relevance and coherence of the output.

1.2 Motivation and Significance

The entire world had several issues during the COVID-19 epidemic, but the one that stood out the most and had a significant impact on the population was mental stress. Anxiety, despair, and post-traumatic stress disorder are the three most prevalent psychiatric issues during COVID 19 (PTSD). The most prevalent mental illnesses in the world are anxiety and depression, and PTSD is a serious mental illness that can arise following exposure to a traumatic event.

The psychological problems that have arisen during COVID 19 are a direct result of the stress and anxiety that come with living in a pandemic. During pandemic mental stress was a very big problem among population and due to lockdowns people were also not able to take help from professional people so looking into this situation to counter this situation Cheerbot which would work as a psychologist and help people to overcome their mental stress. After Pandemic this field has become a major field of research. Moreover, it is found that people are more comfortable in sharing their emotions with a machine then a person. This led to creation of chatbot named 'CHEERBOT ' which can help people to overcome their mental stress and help them to cheer their mood.

The significance of psychological assessment using chatbots:

- **Accessibility:** Chatbots provide a convenient and accessible platform for individuals to assess their mental health.
- **Anonymity and Privacy:** Users often feel more comfortable disclosing personal information to a chatbot due to the anonymity it offers.
- **Early Intervention:** Chatbot assessments can detect mental health issues early, allowing for timely intervention and support.
- **Scalability:** Chatbots can reach a large number of users simultaneously, making them a scalable solution for mental health assessments.
- **Personalization:** Chatbots can tailor assessments to each individual, adjusting questions based on responses and preferences.

1.3 Problem Statement

In an era in which messaging applications are more popular than social networking sites. Most of the companies have turned their business to online mode i.e. through online messaging portals for interacting proactively with users about their products. But it is not so easy to deal with thousands or lakhs of customers manually on a daily basis. They prefer a chatbot, which is a type of messaging platform that can communicate with humans in their language.

Nowadays, people are facing a lot of psychological problems like anxiety, depression, and during the pandemic, these problems have increased a lot. Keeping this in mind, this chatbot is being developed to perform psychological assessments and provide solutions to users. The chatbot technology aims to help people going through depression, anxiety, PTSD, and many more such mental problems.

In order to identify and address the issues that each age group of people in our society faces, this chatbot is being developed. The purpose of this project is to use chatbots to encourage someone who is depressed. Cheerbot can engage in conversations with users that will make them feel better. By exposing it to an inspiring discourse corpus throughout training, it becomes emotionally supportive. Since this is a computer program, it can skill up and skill down the resources depending on the circumstances, which saves time and money.

The creation of a chatbot capable of language translation, holds transformative potential, acting as a catalyst in overcoming language barriers for effective communication and information exchange. Its impact spans diverse sectors, including: healthcare, commerce, and governance etc. offering a versatile solution to bridge linguistic gaps.

1.4 Objectives

As mental health projects are on a boost right now and a lot of people are trying to build projects to help people suffering with depression, mental stress and many other problems. The objectives of the project are as follows:

1. To study the existing literature on Chabot for psychological assessment.
2. To develop a Chabot for psychological assessment using RASA for multiple disorders like depression and anxiety.

3. Deploy the developed Chatbot on webapp.

Features of Psychological Assessment using chatbot:

- **Screening for Mental Health Disorders:** The chatbot can administer standardized questionnaires to identify common mental health disorders like depression, anxiety, or PTSD, providing an initial assessment of the user's mental health.

- **Assessing Symptom Severity:** Through conversation, the chatbot can gauge the severity of specific symptoms experienced by the user, such as mood swings or sleep disturbances, to help understand the level of distress.

- **Identifying Risk Factors:** The chatbot can inquire about various risk factors for mental health issues, like traumatic experiences or family history, to assess the user's vulnerability to certain conditions.

- **Assessing Coping Strategies:** By engaging in dialogue, the chatbot can evaluate the user's coping mechanisms and strategies for dealing with stressors, providing insights into their adaptive or maladaptive coping skills.

1.5 Organization of Report

This project report is made in a way to provide a complete understanding of the Psychological Assessment using chatbot project, discussing its objectives, methodology, implementation, challenges, results, and future scope. The report is organized into six chapters, each dealing with a specific aspect of the project:

Chapter 1: Introduction

This chapter deals with introduction to the Psychological Assessment using chatbot project, providing a brief overview of its purpose, significance, and motivation. It highlights the objectives and problem statement of the project.

Chapter 2: Literature Survey

This chapter presents an overview of relevant literature and key gaps in the literature studied during the making of Psychological Assessment using chatbot application, covering existing research and developments in the field of chatbot.

Chapter 3: System Development

This chapter delves into the requirements and analysis phase of the project. It gives a detailed description of Project Design and Architecture, describes the Data preparation process and Implementation of the project along with the screenshots of the code snippets and finally Key challenges are addressed that were faced during the project.

Chapter 4: Testing

This chapter describes the testing methodology used in testing of the application, explaining the test cases and outcomes for various components of the code.

Chapter 5: Results and Evaluation

This chapter discusses the key findings of the project and their interpretation along with a snapshot of the results.

Chapter 6: Conclusion and Future Scope

This chapter concludes the project report by summarizing the key achievements, contributions and limitations of the Psychological Assessment using chatbot project. It also discusses potential future scope and enhancements for the application.

CHAPTER 02: Literature Survey

2.1 Overview of relevant literature

The literature below utilizing AI encompasses a wide array of topics, reflecting the interdisciplinary nature and depth of research in this field. One major focus is on natural language processing techniques, including sentiment analysis, named entity recognition, and dialogue management, which aim to improve chatbot understanding and response generation.

Additionally, machine learning methods are extensively explored, with research on deep learning models for natural language understanding and generation, reinforcement learning for dialogue management, and supervised learning for intent classification and response generation. User experience (UX) and interaction design are also emphasized, with studies highlighting principles such as conversational UX, persona-based design, and multimodal interaction to create engaging and intuitive chatbot interactions.

Understanding the psychological and behavioral aspects of human-chatbot interactions is another key area, with research examining user trust, satisfaction, and the impact of chatbot personality on engagement. Domain-specific applications, including healthcare, education, customer service, and mental health support, are also a significant focus, requiring specialized knowledge and language understanding capabilities.

Ethical and social implications, such as privacy concerns and algorithmic bias, are important considerations, as are evaluation metrics like accuracy and user satisfaction. Additionally, there is exploration into integrating chatbots with emerging technologies like virtual reality, augmented reality, and the Internet of Things, as well as efforts to develop cross-cultural and multilingual chatbots. Emerging trends such as personalized chatbots, explainable AI, and hybrid human-agent systems are also discussed, along with challenges such as data privacy and the need for advanced AI capabilities.

Overall, this body of research contributes to advancing conversational AI and informs the development of intelligent chatbot systems. Table 1 describes the summary of the literature survey.

Table 1: Literature

S. NO.	TITLE	YEAR	RESULTS	LIMITATIONS
1	Mental Health Assist and diagnosis conversational interface [4]	2023	Takes less time to use assistant Using RASA	Functionality restricted to working with application data.
2	AI based virtual assistant[5]	2023	Capable to take user command	Dependency on data
3	Chatbot costumer services [6]	2022	Chatbot works in the context of customer service Seq2seq	Unable to handle complex quires
4.	The next generation: Chatbots in clinical psychology to Foster Mental Health [7]	2023	A medical chatbot have symptom-based, therapies.	Decision making capacity
5.	AI Chatbot Design during an Epidemic like the Novel Coronavirus[8]	2023	Provided the advantage of putting access to virtual doctors into their hands.	Proposed chatbot is in working phase.
6.	Chatbots in Education and Research[9]	2023	The first research question (RQ1) explores how AI and chatbots could impact the education field, and what their impact is on the integrity of assessments	Practical tasks can discourage use of AI systems as they are difficult to complete using AI.

7.	Role of AI chatbots education [10]	2023	Transformed support service ,improve accessibility, and contribute to more efficient and effective learning environments	Difficulty in the assessing student's work
8.	AI Chatbot [11]	2022	It focus on the value creation and benefit realisation of AI chatbots, empirical studies investigating users' actual experience is limited	The search was limited in English keywords in the journal and the articles from two major databases.
9	NLP for Building Chatbots [12]	2021	This paper discusses the challenges of NLP for building chatbots and provides solutions for addressing these challenges	Context problem and ambiguity
10.	User adaptation of input – response pairs in an example-based dialog system using distributed representation of words [13]	2021	Consider using dedicated chat bot development frameworks like Rasa, Dialogflow, or Microsoft Bot Framework for more refined executions.	Data Dependency, Lack of True Understanding.
11	Research paper on artificial intelligence and its application [14]	2020	The ultimate goal of institutions and scientists working on AI is to solve problems	Replacing humans

12	Chatbot Using Deep Learning [15]	2020	It can be used for a variety of tasks. Generally, it should understand what the user.	Models trained on specific domains may not generalize well .
13	Research on the Design of Intelligent Chatbot Based on Deep Learning [16]	2020	The improved two-way GRU network + Attentin model based on mutual information obtains the final chat robot model after 40 rounds of learning	Due to the openness of the generative chatbot model, there is no unified standard to evaluate the pros and cons of its structure and the quality of the training effect
14	A chatbot for psychiatric counseling in mental healthcare service based on emotional dialogue analysis and sentence generation [17]	2020	A Chatbot using deep learning NMT model with Tensorflow has been developed. The Chatbot architecture was build- up of BRNN and attention mechanism.	Bidirectional RNNs and attention models can be expensive in terms of computation during both training and inference.
15	Artificial Intelligence-Assisted Online Social Therapy for youth mental health, [18]	2020	This chatbot is proposed to be used by i-CATS University College to help in the Marketing department to automate the process of answering FAQs and inquiries.	Users may express emotions in vague ways, making it difficult for the model to accurately interpret their open states.

16	Chatbot Application for Tourism Using Deep Learning [19]	2020	Users will be able to get detailed information of all tourist attractions, activities, culture, heritage and other information of Andaman and Nicobar Island.	cquiring a large and diverse dataset specifically tailored to tourism-related language can be challenging.
17	BUILDING A SMART CHATBOT [20]	2020	This chatbot is helpful in guiding students with correct source of information easily. We got an Accuracy of 94%	Chatbots developed for specific domains may struggle to generalize to unfamiliar topics.
18	How AI-Chatbots Can Make Dubai Smarter [21]	2019	Managed to respond to more than 698,000 inquiries which encouraged DEWA.	Customer - centric services was quite expensive
19	Towards a chatbot for [22]	2019	The chatbot provides fast response	It is often impossible
20	digital counselling [23]	2019	efficient search for answers to the queries and gets the relevant links to their question.	to get all the data on a single interface without the worries of going through multiple forms and windows

21	User Experience Contrast of Intelligent Personal Assistants [24]	2018	Uses of various types of chatbots and comparison of their user experience.	Still improving the quality of the answers that the assistants provided.
22.	Bringing AI into the Classroom : Designing Smart Personal Assistants as Learning Tutors [25]	2018	we contribute to the field of computer tutoring by providing prescriptive knowledge on how educators can design new forms of ITS (SPAs).	It is important to understand how SPAs can be used in education.
23.	Artificially Intelligent Self- Driving Vehicle Technologies, Benefits and Challenges [26]	2018	Reduce Transportation-Related Pollution, System Reliability and the Cybersecurity,Improve Access to Transportation.	Any decision that will be taken self-directed vehicles may affects either the passenger or road user.
24.	Designing a Personal Assistant for Life-Long Learning (PAL3) [27]	2016	Compared to other approaches to providing intelligent support for learning, we believe PAL3 is novel in several regards.	Future work will study the efficacy of PAL3 for supporting learning among sailors between A School and C School.

2.2 Key Gaps in the Literature

1. Long-term Effectiveness and User Adoption: Many studies focus on short-term outcomes and user satisfaction, but there's a gap in research on the long-term effectiveness of chatbots across various domains such as mental health, education, and customer service. Moreover, understanding factors influencing user adoption and sustained engagement with chatbot technologies over time remains underexplored.

2. Personalization and Context Awareness: While some chatbots offer personalized experiences, there's room for improvement in tailoring interactions to individual user preferences, needs, and contexts. More research is needed to develop chatbots with advanced personalization capabilities and context awareness to enhance user experience and effectiveness.

3. Integration with Human Interaction: Limited research addresses how chatbots can seamlessly integrate with human interaction, especially in domains where human empathy and understanding are crucial, such as healthcare and counseling. Finding the optimal balance between automated and human interaction is crucial for maximizing the benefits of chatbot technology.

4. Cross-cultural and Multilingual Adaptation: Most studies focus on chatbots developed for English-speaking users in Western contexts, overlooking the cultural and linguistic diversity of global populations. There's a need for more research on developing culturally sensitive chatbots adaptable to different languages and cultural norms.

5. Explainability: As chatbots become more complex, there's a growing demand for transparency and explainability in their decision-making processes. However, research on designing chatbots that can explain their reasoning and build trust with users, particularly in critical domains like healthcare and finance, is limited.

CHAPTER 03: SYSTEM DEVELOPMENT

3.1 Requirements and Analysis

3.1.1 Language Used: Python3.11.2

3.1.2 Technical Requirements:

- A computer with at least 4GB of RAM and a multicore processor
- Internet Connection

3.1.3 Software:

- Python 3.5 or higher
- Visual studio Code or any other code editor

3.1.4 Libraries:

- os
- nltk
- numpy as np
- json
- sklearn.metrics import classification_report, confusion_matrix
- matplotlib.pyplot
- nltk.stem.lancaster
- LancasterStemmer
- string import punctuation

3.1.5 Additional Requirements:

Operating System Requirements:

- Ensure that the operating system (Windows, Linux, macOS) supports the required.

3.1.6 Functional Requirements:

1.Text Processing:

- Tokenize input text using NLTK.
- Remove punctuation and stopwords.
- Apply stemming using LancasterStemmer.

2.Data Handling:

- Load and preprocess input data (e.g., JSON format).
- Handle user queries and inputs dynamically.

3.Machine Learning:

- Train classification models using scikit-learn.
- Evaluate model performance using classification_report and confusion_matrix.

3.1.7 Response Generation:

- Generate appropriate responses based on user input.
- Use a predefined set of responses or machine learning models to generate replies.

3.1.8 Non Functional Requirements:

- Define project aim / objectives, specify the problem that the model needs to solve.
- Find the required datasets according to the need of the model,data set selected must be selected in such a way that it is easy to train and validate.
- Perform exploratory data analysis (EDA) to understand the characteristics of the data. Select the correct type of NLP model based on nature of problem.

3.1.9 For developing Cheerbot used two approaches:

1. Using RASA

2. Using Seq2Seq and LSTM modules of python

3.1.9.1 USING RASA:

RASA is a machine learning framework for creating contextually oriented chat and voice AI assistants. There are two modules in it:

- RASA NLU (NATURAL LANGUAGE UNDERSTANDING)
- The dialogue management component of RASA CORE.

RASA NLU functions as an ear for chatbots and virtual assistants, enabling the chatbot to comprehend what the user is saying or entering. It accepts users' simple, unstructured natural language input and then extracts the data that is structured in the form of intents and entities.

Rasa NLU's many components, the majority of which have some extra requirements, can recognise intents and entities.Spacy (You need to install it separately) Use Tensorflow (By Default available with Rasa.

INTENTS: According to the overarching objective of each user's input, labels called intents are applied to it.

Example: User's input:
"HELLO" So his intent is: "
GREET "

ENTITIES: entities are the bunch of information that a chatbot may need in a certain context.
Example: my name is " SIDDHARTH
" He inputted his name.
A chatbot should be able to extract his name and remember it till the conversation is completed to keep the
interaction natural.

One can refer to the DIALOGUE MANAGEMENT COMPONENT, often known as "CORE," as the chatbot's "brain." It deals with the appropriate chatbot response given the context and conversational state. CORE learns by identifying trends in conversational data—also known as stories—between a user and a chatbot.

A machine learning model under the hood takes into account quite a few details. It looks at what the conversation is currently about and also looks back at what has been said before. In addition to this, the model also takes into account the details extracted by the NLU model.

Simple concepts on which the whole chatbot development using RASA in based are:

- The user message for the chatbot to obtain information is referred to as a question.
- Action: A chatbot's reaction to a user message is called an action.
- Intents: The purpose or goal behind a user's input, such as "hi," "hello," "good morning," "good evening," etc. can be interpreted as a greeting.
- Entities: One way to think about entities is as useful data that may be gleaned from user input (The nouns in the dialogue). For instance, in the sentence "I want to book a ticket from DELHI to COCHIN," both Delhi and Cochin are recognised as separate entities.

Architecture contains 4 things:

- Interpreter
- Tracker
- Policy
- Action

The Interpreter will receive a message that a user enters and sends to the RASA chatbot. The message's purpose is determined by the interpreter, who also extracts the message's entities.

A Tracker is in place to continually keep track of the communication between the user and the bot. The architecture's policy is in charge of keeping track of the status of the current discussion and selecting the right bot answer. The tracker also tracks the reply, which is then forwarded to the user as the reply.

3.1.9.2 USING Seq2Seq:

Sequence-to-Sequence are deep learning models that have been proved very successful for tasks like text summarization and image captioning.

Encoders and decoders are both parts of the Seq2Seq paradigm. The input is taken by the encoder, which records its context as a hidden state vector before sending it to the decoder, which creates an output sequence. It guesses a word from the user's input before utilising that word's likelihood of occurrence to forecast each of the subsequent words.

A final state vector (memory) is the encoder's output; this vector serves as the decoder's input state. The decoder is trained using a technique known as instructor forcing so that it can anticipate the subsequent words in a target sequence that is provided by the previous words. States are sent from the encoder to each layer of the decoder. The words "hello," "how are you," "are," and "you" are referred to as input tokens, whereas "I," "am," and "fine" are target tokens. The encoder states and the preceding words determine how likely the token "am" is to appear. To tell our decoder when to stop a token "END>".is added

Each token in the input sequence is processed by the encoder. It tries to fit all the data about the input sequence into the "context vector," a vector with a set length. The encoder sends this vector to the decoder after processing each token in turn.

Context vector: The vector is constructed so that it should fully capture the intent of the input sequence and aid the decoder in producing correct predictions.

Decoder: The decoder reads the context vector and makes token-by-token predictions about the target sequence. Both blocks' internal architecture would resemble this in some way.:

Long short term memory [LSTM]

Short and long-term A unique class of RNN, memory networks are capable of learning long-term dependencies.

They are intended to prevent the issue of long-term reliance. They may retain knowledge for a very long time. Although LSTMs have a structure like a chain, each repeating module has a unique structure.

RNN faces the problem of keeping long term memory because due to vanishing gradient problem RNN have short term memory so don't remember much of previously given input.

3.2 Project Design and Architecture

3.2.1 Working of the Chatbot

Figure 3.2.1 Shows structure of the chatbot: Chatbot takes user input in the form of text. First the user is asked about its username and the wen the user enters its username then it asks about the mail id of the user after the user enters its details then the bot compares the registered information to the database. Then user enters its mobile number. then the chatbot divides the user based on the details into age categories.

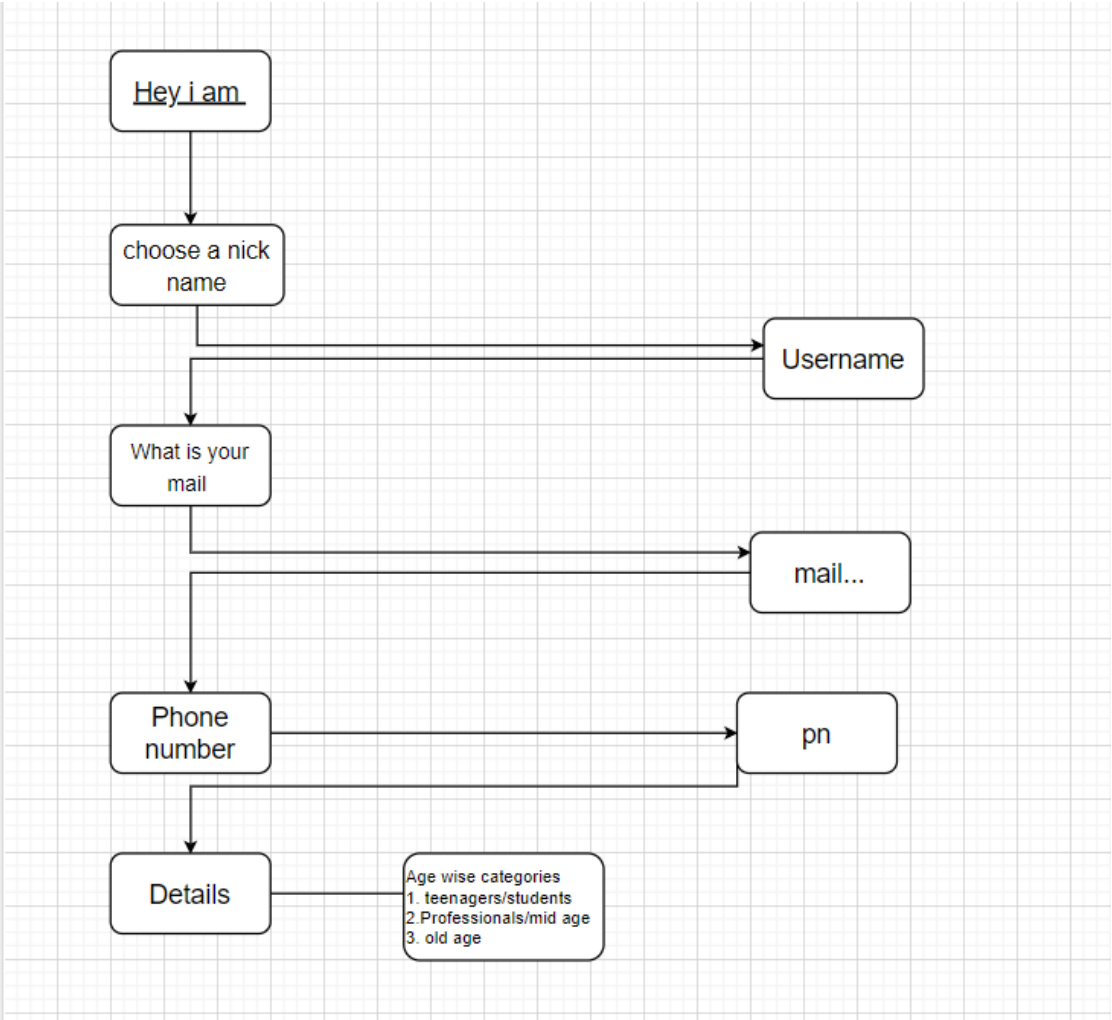


Fig 3.2.1. Working flowchart of our chatbot

Flowchart shows query is send to chatbot and chatbot is decoding information from the user.

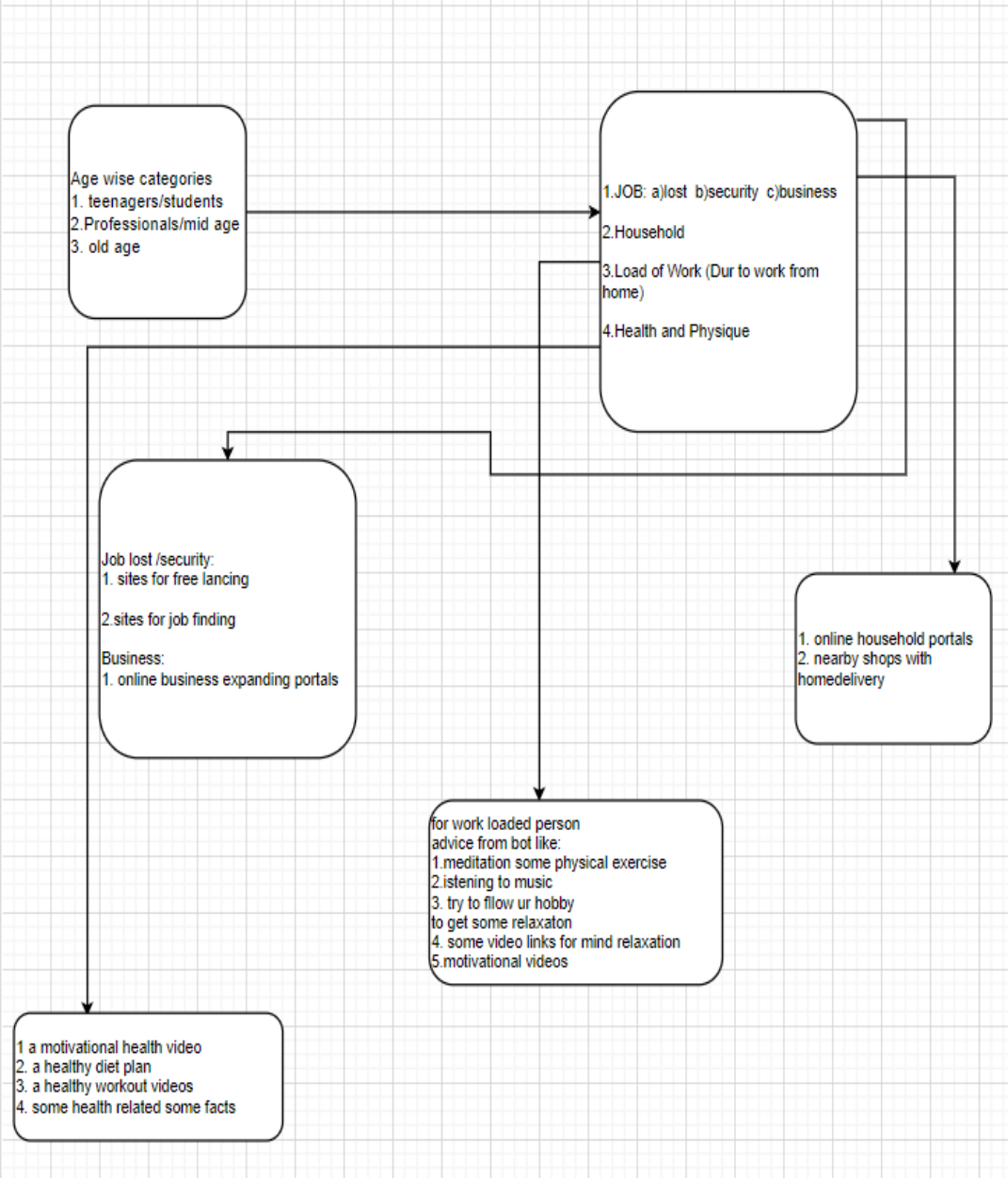


Fig 3.2.2Working flowchart of our chatbot

3.2.2 Chatbot using RASA: CHEERBOT

Scope of our chatbot: Cheerbot is designed to know the problems faced by each age group of people of our society and help them to overcome that problems in this pandemic.

Age-group

- TEENAGER AND STUDENTS
- PROFESSIONALS/ MID AGE GROUP
- OLD AGE GROUP PEOPLE

3.2.3 PROBLEMS FACED BY TEENAGERS AND STUDENTS:

1. EFFECT ON STUDIES: From the past six months, the field which is being affected by the pandemic most is the educational field. All the schools/colleges are closed and students have to suffer their studies for that. This has affected their concentration and focus towards studies.

2. BORED AND LONELINESS: In this age, when every student has a gesture to live his/her own kind of life, this pandemic shut all the doors for them to expose themselves, students are away from their friends and their studies which results in them to feel bored and lonely. This boredom and loneliness could further lead to bigger problems.

    a.) OVERTHINKING AND ANXIETY: This age group of people have a rapid mind- set and if they use it in a wrong way, then a big problem related to their career may occur. Due to lockdown and boredom over thinking becomes a bigger issue for this age.

    b.) HEALTH AND PHYSIQUE: Health and physique are equally important as studies for teenagers. But in this pandemic, gyms as well as the parks are closed , so the people are unable to control their diet and are unable to do exercises or play outside.

3.2.4 PROBLEMS FACED BY MID AGE GROUP PEOPLE:

1. JOB LOST/ JOB SECURITY/ BUSINESS LOSS: Suddenly, this pandemic came and affected the mid age group very much because many people had to lose their jobs because everything was shut, business leaders also suffered a big loss during the pandemic.

2. HOUSEHOLD FINANCES: Those who lost their jobs in the pandemic are the ones who earn from the daily basis work and fulfill their livelihood. But they had to leave their houses in this pandemic.

3. LOAD OF WORK DUE TO WORK FROM HOME: Someone lost their job, so someone has to fill his place by doing extra work in the same income for their job security, they didn't get a single leave (even on weekends) throughout the pandemic.

4. HEALTH AND PHYSIQUE: To maintain their body and to prepare themselves for the work, physical as well as the mental preparation are important, that was nor possible in the pandemic due to extra load of work , so it results in causing laziness in people.

3.2.5 PROBLEMS FACED BY OLD AGE GROUP PEOPLE:

1 BORED AND LONELINESS: It is impossible for any age group of people to stay in his bed throughout a day and due to this pandemic, old age people also got stuck in their houses.

2 LACK OF MEDICAL FACILITIES: Normal hospitals turned into covid hospitals, so the old age people who suffer from regular diseases like diabetes, blood pressure had to suffer for their treatment.

3 HEALTH AND PHYSIQUE: It is seen that this age group people love to go out in natural air to feel fresh and do yoga and different activities with their mates in parks but in this pandemic, it couldn't be possible.

4 CORONA PHOBIA: For those, who've never seen this kind of pandemic throughout his life watch the news during the pandemic, this amount of people get corona positive on this day and this amount of people have lost their life suffers with a phobia which affects their mental strength.

3.3 Implementation:

We discussed the problems faced by each age group of people throughout the pandemic above. Here, we will discuss how our chatbot deals with those problems and show the correct path to the people through which people feel comfortable and their mind can be diverted from covid's fear somehow. Our chatbot will show different instructions to different age group people.

3.3.1 SOLUTIONS FOR TEENAGERS:

- STUDIES: our chatbot helps teenagers by showing elaborative interrogation which helps the user to bring back their focus in their studies.
- BORED AND LONELY: our chatbot helps the user by reminding them in which fields they are successful before and have interest, which helps the user to feel exhaustive not bored.
- HEALTH AND PHYSIQUE: for fitness lovers, our chatbot provides the diet charts as well as some best recommended online videos for both girls and boys.
- ANXIETY AND OVERTHINKING: to come out of anxiety, our chatbot provides some religious videos too to keep their mind fresh and feel cool.

3.3.2 SOLUTIONS FOR MID AGE GROUP PEOPLE:

- JOB RELATED ISSUE: for those, who've lost their job and have talent in any field, our chatbot helps them by introducing and getting familiar with job finding sites like linkedin, internshala, truelancer etc.

- WORK STRESS: our chatbot helps people who are working from home by telling them some exercises to feel fresh, by telling them a healthy and nutritious diet to feel energetic while performing.

- HEALTH AND PHYSIQUE: for fitness lovers, our chatbot provides the diet charts as well as some best recommended online videos for both girls and boys.

3.3.3 SOLUTIONS FOR OLD AGE GROUP PEOPLE:

- MEDICAL FACILITIES: everyone knows that keeping themselves at home is the biggest precaution at this time, keeping this in mind, our chatbot helps them by introducing some online medical facilities and apps which support online doctor support.

- BOREDOM: our chatbot helps this age group people by developing new hobbies by making them familiar with the use of the internet.

- COVID PHOBIA: our chatbot suggests these age group people to avoid watching news on TV and phone and to watch some funny shows or movies to divert their mind.

3.4 KEY CHALLENGES

3.4.1 Chatbot using Seq2Seq

Since NLP enables chatbots to learn and emulate the patterns and styles of human communication, it was employed for generative-based chatbots. You get the impression that you are speaking to a person rather than a machine. It links user input to an intent in order to categorise the message for the best potential predetermined response. On the CSV file, an encoder-decoder model was trained. The encoder-decoder model, also known as a seq2seq model, uses Long Short Term Memory (LSTM) to generate text from the training corpus.

3.4.2 Chatbot Using LSTM

Short and long-term A unique class of RNN, memory networks are capable of learning long-term dependencies.

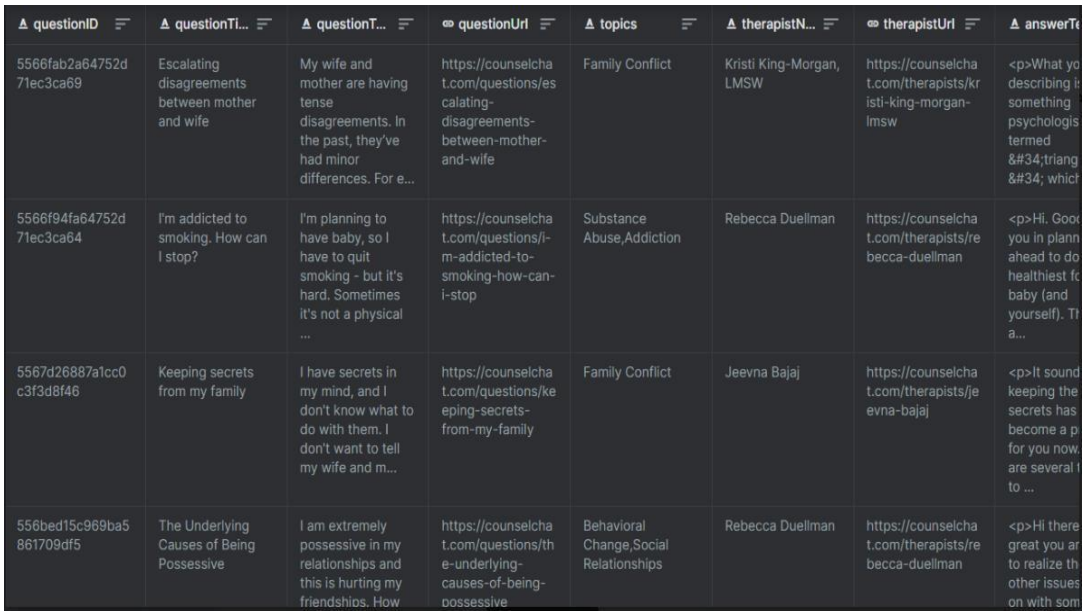
They are intended to prevent the issue of long-term reliance. They may retain knowledge for a very long time. LSTMs have a structure that resembles a chain, yet each repeating module has a unique structure.

RNN faces the problem of keeping long term memory because due to vanishing gradient problem RNN have short term memory so don't remember much of previously given input. LSTMs model stores long term memory as well. LSTM model stores the important keyword in the form of long term memory.

3.5 DATASET

The dataset for the Seq2Seq chatbot was taken from the Kaggle Mental Health FAQ dataset [28], which contains 98 FAQs regarding mental health. There are three columns in it: QuestionID, Questions, and Answers.

Figure 3.5.1 Pre-processed Data



questionID	questionTi...	questionT...	questionUrl	topics	therapistN...	therapistUrl	answerTe
5566fab2a64752d71ec3ca69	Escalating disagreements between mother and wife	My wife and mother are having tense disagreements. In the past, they've had minor differences. For e...	https://counselchat.com/questions/escalating-disagreements-between-mother-and-wife	Family Conflict	Kristi King-Morgan, LMSW	https://counselchat.com/therapists/kristi-king-morgan-lmsw	<p>What yo describing i something psychologis termed "triang " whicl
5566f94fa64752d71ec3ca64	I'm addicted to smoking. How can I stop?	I'm planning to have baby, so I have to quit smoking - but it's hard. Sometimes it's not a physical ...	https://counselchat.com/questions/i-m-addicted-to-smoking-how-can-i-stop	Substance Abuse,Addiction	Rebecca Duellman	https://counselchat.com/therapists/rebecca-duellman	<p>Hi. Gooc you in plann ahead to do healthiest fc baby (and yourself). Tl a...
5567d26887a1cc0c3f3d8f46	Keeping secrets from my family	I have secrets in my mind, and I don't know what to do with them. I don't want to tell my wife and m...	https://counselchat.com/questions/keeping-secrets-from-my-family	Family Conflict	Jeevna Bajaj	https://counselchat.com/therapists/jeevna-bajaj	<p>It sound keeping the secrets has become a p for you now are several t to ...
556bed15c969ba5861709df5	The Underlying Causes of Being Possessive	I am extremely possessive in my relationships and this is hurting my friendships. How	https://counselchat.com/questions/the-underlying-causes-of-being-possessive	Behavioral Change,Social Relationships	Rebecca Duellman	https://counselchat.com/therapists/rebecca-duellman	<p>Hi there great you ar to realize th other issues on with som

Figure 3.5.2 Dataset used in LSTM model

../input/maindata/counsel_chat.csv

questionTi...	questionT...	questionLi...	topic	therapistIn...	therapistU...
Can I change my feeling of being worthless to everyone?	I'm going through some things with my feelings and myself. I barely sleep and I do nothing but think...	https://counselchat.com/questions/can-i-change-my-feeling-of-being-worthless-to-everyone	depression	Sherry Katz, LCSWCouples and Family Therapist, LCSW	https://counselchat.com/therapists/sherry-katz-lcsw
Can I change my feeling of being worthless to everyone?	I'm going through some things with my feelings and myself. I barely sleep and I do nothing but think...	https://counselchat.com/questions/can-i-change-my-feeling-of-being-worthless-to-everyone	depression	Robin Landwehr, DBH, LPCC, NCCMental Health in a Primary Care Setting	https://counselchat.com/therapists/robin-landwehr-dbh-lpcc-ncc
Can I change my feeling of being worthless to everyone?	I'm going through some things with my feelings and myself. I barely sleep and I do nothing but think...	https://counselchat.com/questions/can-i-change-my-feeling-of-being-worthless-to-everyone	depression	Lee KingI use an integrative approach to treatment and have an online therapy practice.	https://counselchat.com/therapists/lee-king
Can I change my feeling of being worthless to everyone?	I'm going through some things with my feelings and myself. I barely sleep and I do nothing but think...	https://counselchat.com/questions/can-i-change-my-feeling-of-being-worthless-to-everyone	depression	Shauntai Davis-YearginPersonalized, private online counseling for individuals and couples	https://counselchat.com/therapists/shauntai-davis-yeargin
Can I change my	I'm going through	https://counselcha	depression	Jordan	https://counselcha

Figure 3.5.3 Pre-processed dataset used in LSTM model

For LSTM a mental health dataset called counsel chat dataset, it consisted of the different questions that the people suffering with PTSD, anxiety and depression asked the psychiatrist. The answers from the psychiatrist were recorded as well.

CHAPTER 04: TESTING

4.1 TESTING STRATEGY

1. Unit Testing:

- **Objective:** Verify individual components of the NLP model.
- **Tools:** Python testing frameworks (e.g., pytest), NLP-specific libraries (e.g., NLTK, SpaCy).

2. Integration Testing:

- **Objective:** Check how well different modules of the chatbot work together.
- **Tools:** Testing frameworks, custom scripts, and tools for simulating user interactions.

3. Functional Testing:

- **Objective:** Validate if the chatbot meets specified requirements.
- **Tools:** Selenium for testing web-based chatbots, custom scripts for API-based chatbots.

4. Performance Testing:

- **Objective:** Evaluate the chatbot's response time, handling of concurrent users, and scalability.
- **Tools:** Apache JMeter, Locust, Gatling.

5. Security Testing:

- **Objective:** Identify and rectify vulnerabilities in the chatbot.
- **Tools:** OWASP ZAP, Burp Suite, code analysis tools.

6. Regression Testing:

- **Objective:** Ensure that new updates or features do not break existing functionalities.
- **Tools:** Automated testing frameworks, version control systems.

7. Usability Testing:

- **Objective:** Evaluate how user-friendly the chatbot is.
- **Tools:** User feedback surveys, usability testing platforms.

8. NLP-Specific Testing:

- **Objective:** Assess the accuracy and performance of NLP models.
- **Tools:** SpaCy, NLTK, custom evaluation metrics, human evaluators for subjective tasks.

9. End-to-End Testing:

- **Objective:** Verify the entire chatbot system, including user inputs, NLP processing, and responses.
- **Tools:** Custom scripts, end-to-end testing frameworks.

10. Continuous Integration/Continuous Deployment (CI/CD):

- **Objective:** Automate testing in the development pipeline to catch issues early.
- **Tools:** Jenkins, GitLab CI, Travis CI.

11. Monitoring and Logging:

- **Objective:** Keep track of chatbot performance and identify issues in real-time.
- **Tools:** ELK Stack (Elasticsearch, Logstash, Kibana), Prometheus, Grafana.

12. Exploratory Testing:

- **Objective:** Discover unexpected issues by exploring the chatbot without predefined test cases.
- **Tools:** Manual testing by QA engineers, leveraging their creativity and domain knowledge.

13. Chatbot Simulator Tools:

- **Objective:** Simulate user interactions for testing various scenarios.
- **Tools:** Botpress, Microsoft Bot Framework Emulator.

14. Multi-language Testing:

- **Objective:** Ensure the chatbot performs well with different languages.
- **Tools:** Translation services, language-specific NLP libraries.

4.2 Testing

1. Add the model in the root project directory.

2. The following instructions were tested on the Windows with Python 3.8.

   2.1 Clone this repository

   ```
   cd Mental-health-Chatbot/
   ```

   2.2 Create and activate virtual environment

   ```
   python -m venv venv
   ```

   2.3 Install requirements

   ```
   pip install  -r requirements.txt
   ```

   2.4 Run

   ```
   --app app --debug run
   ```

CHAPTER 05: Result and Evaluation

5.1 Results

Our chatbot was created utilising the RASA. RASA is an machine learning framework for creating contextually oriented chat and voice AI assistants. With an accuracy rate of exactly 85%, it can respond to user messages with the appropriate information.

5.1.1 Model

Rasa uses a series of parts to process incoming messages. In a so-called processing pipeline that is specified in your config.yml file, these components are run one after the other. By selecting an NLU pipeline, you may modify and improve your model based on your dataset.

Code Snippet:

```
# Configuration for Rasa NLU.
# https://rasa.com/docs/rasa/nlu/components/
language: en
pipeline:
  - name: HFTransformersNLP
  - name: LanguageModelTokenizer
  #- name: ConveRTFeaturizer
  #- name: SpacyNLP
  #- name: WhitespaceTokenizer
  - name: LanguageModelFeaturizer
  - name: RegexFeaturizer
  - name: LexicalSyntacticFeaturizer
  - name: CountVectorsFeaturizer
  - name: CountVectorsFeaturizer
    analyzer: "char_wb"
    min_ngram: 1
    max_ngram: 4
  - name: DIETClassifier
    batch_strategy: sequence
    epochs: 100
  - name: EntitySynonymMapper
  #- name: CRFEntityExtractor
  - name: ResponseSelector
    epochs: 100

# Configuration for Rasa Core.
# https://rasa.com/docs/rasa/core/policies/
policies:
- name: TEDPolicy
  max_history: 10
  epochs: 20
- max_history: 6
  name: AugmentedMemoizationPolicy
- name: FormPolicy
- name: MappingPolicy
```

Fig 5.1.1 Pipeline Model of Chatbot

5.1.2 Snapshot of User Interface

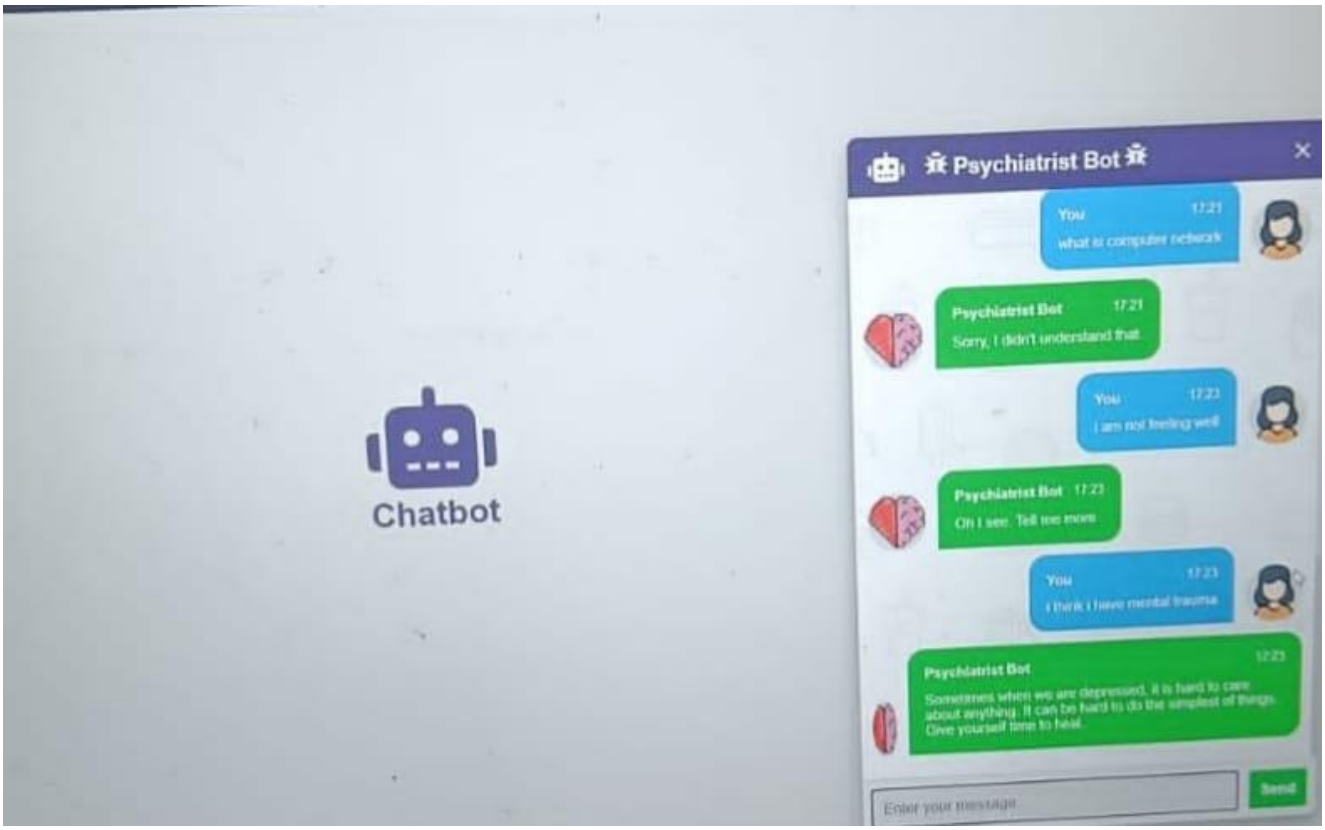


Fig 5.1.2 User Interface

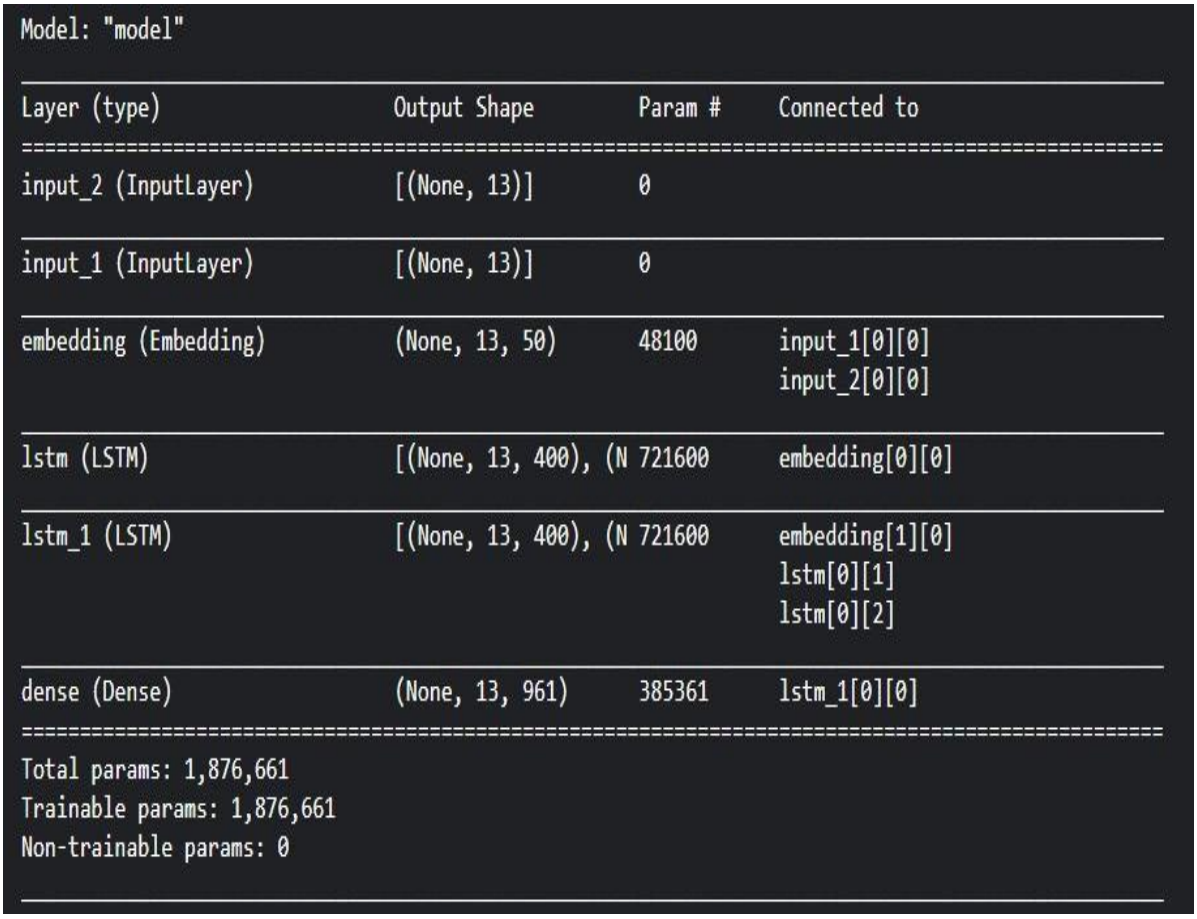
Here chatbot and user are interacting with each other by query generation.

5.1.3 Training the model

Figure 5.1.3 Training the seq2seq model

Training a seq2seq model involves feeding it paired sequences so it can learn to map inputs

to outputs effectively. Model Summary



```
Model: "model"
_________________________________________________________________________________________________
Layer (type)                 Output Shape              Param #     Connected to
=================================================================================================
input_2 (InputLayer)         [(None, 13)]              0
_________________________________________________________________________________________________
input_1 (InputLayer)         [(None, 13)]              0
_________________________________________________________________________________________________
embedding (Embedding)        (None, 13, 50)            48100       input_1[0][0]
                                                                   input_2[0][0]
_________________________________________________________________________________________________
lstm (LSTM)                  [(None, 13, 400), (N 721600      embedding[0][0]
_________________________________________________________________________________________________
lstm_1 (LSTM)                [(None, 13, 400), (N 721600      embedding[1][0]
                                                                   lstm[0][1]
                                                                   lstm[0][2]
_________________________________________________________________________________________________
dense (Dense)                (None, 13, 961)           385361      lstm_1[0][0]
=================================================================================================
Total params: 1,876,661
Trainable params: 1,876,661
Non-trainable params: 0
_________________________________________________________________________________________________
```

Figure 5.1.4 Summary of the model

This training process uses optimization techniques to adjust the model's parameters for better performance.

5.1.4 Model Structure

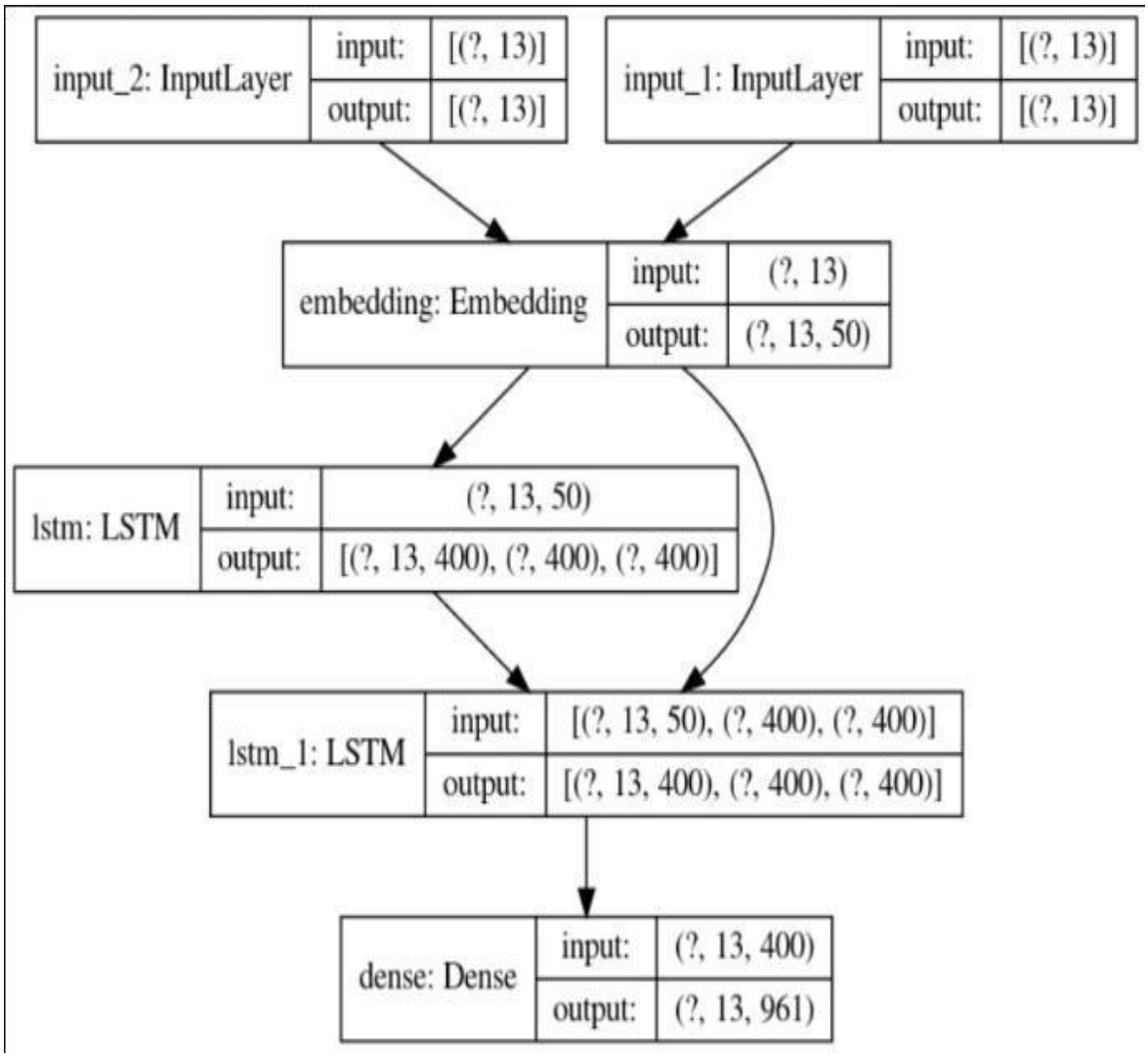


Figure 5.1.5 Model plot

Model structure of LSTM with different input layers.

5.2 Chatbot Using LSTM

5.2.1 Training the model

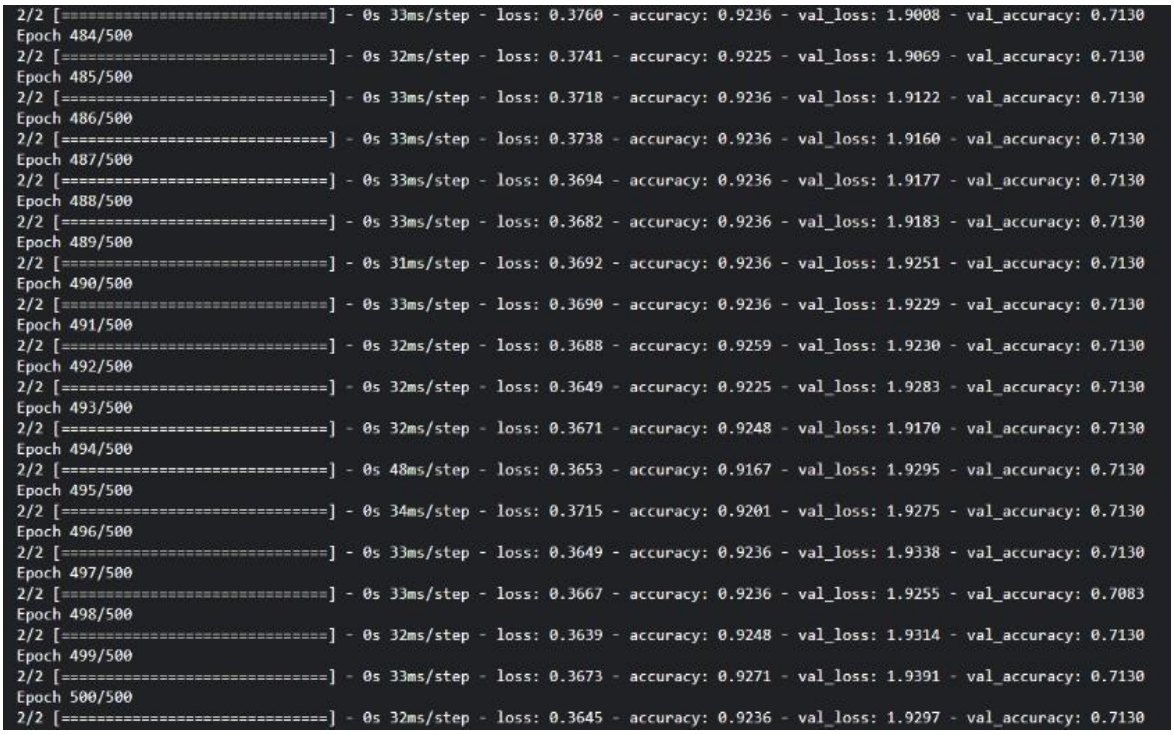


Figure 5.2.1 Training the LSTM model

Training an LSTM model entails providing it with time-series data to recognize patterns across sequences.

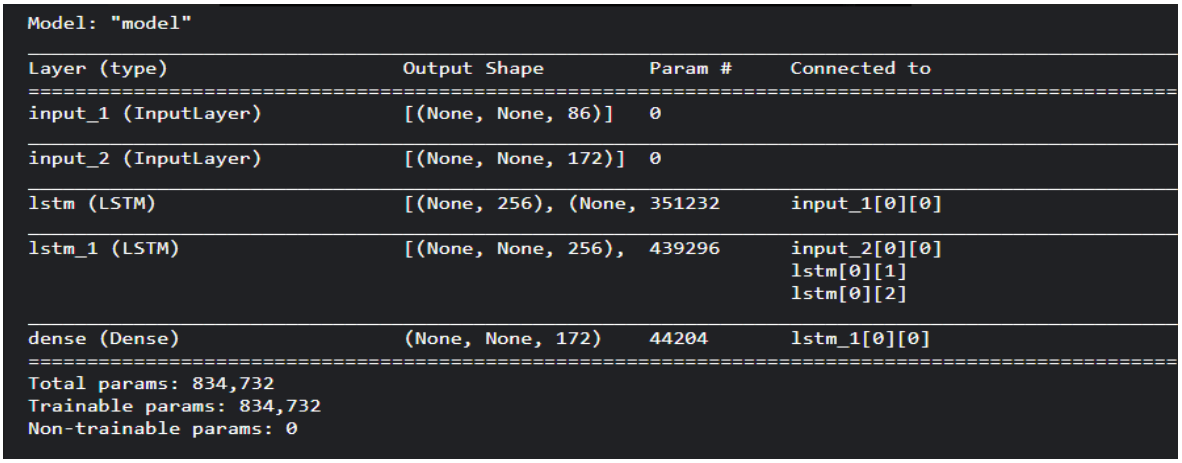


Figure 5.2.2 Model summary of LSTM

5.2.2 Model Structure

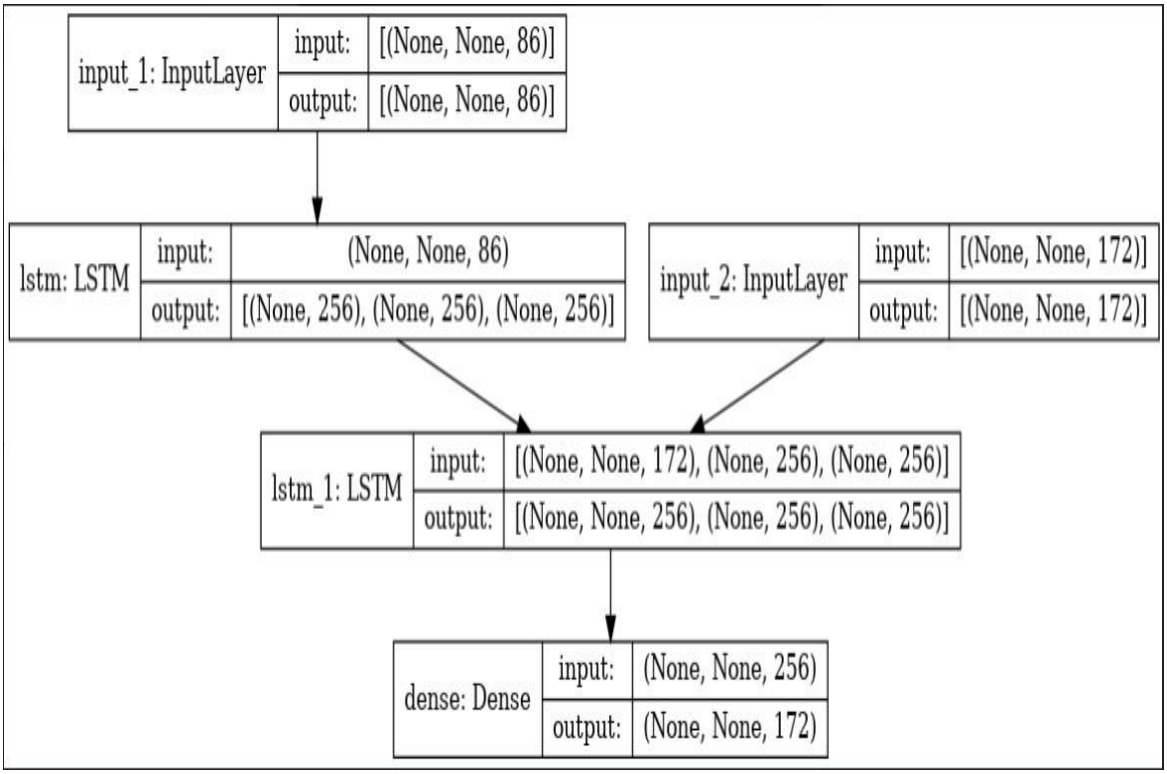


Figure 5.2.3 Model plot

The model's weights are adjusted using backpropagation to enhance its predictive capabilities.

5.2.3 Final Result

Fig 5.2.4 Live working of Chatbot

5.2.4 Analysis

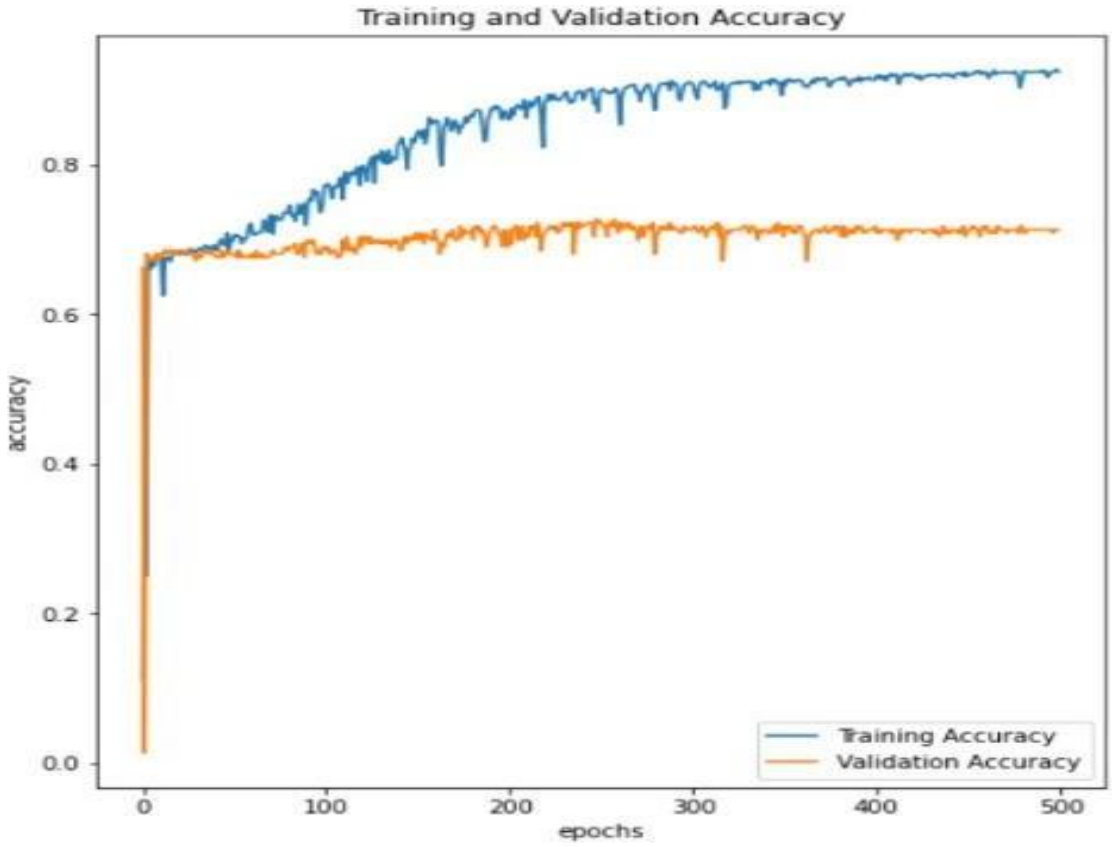


Figure 5.2.5 Training & Validation Accuracy.

Training and validation accuracy for an LSTM chatbot measure its performance in understanding and generating responses where training accuracy is above 0.6.

CHAPTER 06: Conclusion and Future Scope

6.1 Conclusions

Cheerbot is both retrieval and generative chatbot. Accuracy for our generative chatbot is lesser as compared to retrieval chatbot and this is due to less amount of dataset available and its model require heavy computational machine.

Generative chatbot provide more human like experience as compared to retrieval based chatbot but the accuracy of generative Chatbots are not very good till now and research is being done to improve its accuracy.

Cheerbot an effort to make user so familiar to it , so that they can share everything with a bot including those things which a user can not share with anyone else, cheerbot wants to make them feel comfortable with our bot most. Chatbots are considered as new apps, which can give a human-like touch to some aspects and make it easier to have a healthy and enjoyable conversation with the users.

CHEERBOT, has a limited data set because it is working to solve the problems of people in a single domain which is mental stress, but now, it will be updated continuously and to enter in different domains under the psychology field. In order to let people engage with computers organically or in accordance with a set of rules to facilitate their job, our next step in developing chatbots will be to do so.

6.2 Future Scope

In future Cheerbot's scale can increase with more problems and solutions adding to it and providing more data set to the bot for every situation so that it can also deal with people the same way like a living psychologist would do. And moreover the bot would become capable of making your online appointment with a real psychologist in very serious situations. In order to help users interact with computers naturally or in accordance with a set of rules while also facilitating their work, the next step in the development of chatbots is to do so. Our goal is to create a bot that can communicate with both multiple users and multiple bot users.

6.3 Applications Contributions

Our Project have a lot of valuable application in the real world as mental health has become a bigger issue and this chatbot will act as their personal psychologist and help them to overcome anykind of mental stress the user is facing.

It will help people of all age and as according to study people are more comfortable in sharing their feeling with a chatbot rather than a human being. So it could revolutaionalize the medical field.

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