



Preliminary identification and Therapeutic Support of Depression in Mental Health using
Conversational AI

MSc Thesis Research Proposal

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Table of Contents

List of Tables.....	3
List of Figures.....	4
Abbreviation.....	6
Abstract.....	7
Acknowledgement.....	8
1.Introduction	
1.1.Background and Context.....	9
1.2.Problem Statement.....	9
1.3.Organization of the report.....	10
1.4.Summary.....	11
2.Literature Survey	
2.1.Overview.....	12
2.2. A Conversational Chatbot to treat people with major depression: CARO.....	12
2.3. A Cognitive Behavioural Therapy to Treat Students with Depression using Intelligent Chatbot.....	13
2.4. Digital Psychiatry.....	17
2.5. A Chatbot for depressed people.....	17
2.6. Summary.....	18
3.Research design	
3.1.Overview.....	19
3.2.System Architecture Explanation.....	19
3.3.Modules explained.....	20
3.4.Summary.....	27
4.Methodology	
4.1.Methodologies explained in detail.....	28
4.2.Methods used in proposed system.....	38
4.3.Summary.....	41
5.Implementation.....	42
5.1.Summary.....	54
6.Conclusion & Future Works.....	55
References.....	56

List of Tables

Table.2.3.1 HAN, CNN and RNN results	16
Table.2.5.1.Classification of emotions using LSTM[25].....	18

List of Figures

Fig.2.2.1. System architecture of CARO	13
Fig.2.3.1. Identification of Mental State using user's text.....	14
Fig.2.3.2. Testing and Training process.....	14
Fig.2.5.1. System architecture in the proposed system.....	17
Fig.3.2.1. System architecture of proposed system.....	20
Fig.3.3. 1.Tokenization.....	22
Fig.3.3.2 Removing Stop words from the list of words.....	23
Fig.3.3.3. Example of Stemming.....	24
Fig.3.3.4.Lemmatization.....	25
Fig.3.3.5. Lower casing.....	26
Fig.3.3.6. Removing punctuation.....	26
Fig.4.1.1.Sentiment analysis.....	28
Fig.4.1.2.Sentiment analysis for Nike.....	29
Fig.4.1.3.Sentiment score of Nike	29
Fig.4.1.4. Hootsuite dashboard.....	30
Fig. 4.1.5.Sentiment analysis classification techniques.....	30
Fig. 4.1.6.Levels in sentiment analysis.....	31
Fig.4.1.7.Working of chatbot.....	32
Fig.4.1.8.Distinguishing Chatbots vs Conversational agent vs. virtual agents.....	32
Fig. 4.1.9.History of chatbot.....	33
Fig. 4.1.10.Example of conversation with Eliza.....	33
Fig. 4.1.11.Example of conversation with ALICE.....	36
Fig. 4.1.12.Hierarchy of widgets.....	38
Fig.4.2.1. Dialogflow's Intent creation with traing phrases.....	40
Fig.4.2.2. Dialogflow's Intent creation with responses.....	40
Fig.5.1.Code snippet of libraries	42
Fig.5.2.Code snippet of flutter dependencies.....	42
Fig.5. 3.Sign in page	43
Fig.5.4.Account creation page	43
Fig.5.5.Homepage with floating button.....	44
Fig.5.6.Homepage with expanded floating button.....	44
Fig.5.7.Code snippet of Floating button	45
Fig.5. 8.Set of collection	46
Fig.5.9.Code snippet of Set of collection.....	46
Fig.5.10.Code snippet for set of collections.....	47

Fig.5.11.Music page	47
Fig.5.12.Code snippet for music page.....	48
Fig.5.13.Video page.....	48
Fig.5.14.Code snippet for video	49
Fig.5.15.Consultant page.....	49
Fig.5.16.Scheduling appointment.....	50
Fig.5.17.Code snippet for scheduling appointment.....	50
Fig.5.18.QNa screenshot.....	51
Fig.5.19.Code snippet of Greeting message.....	51
Fig. 5.20.Code snippet for Alert message	52
Fig.5.21.Code snippet of Alert message when the survey result is positive	52
Fig.5.22. Code snippet of Alert message to consult professional.....	53
Fig.5.23.Code snippet of Alert message if the survey result is negative.....	53

Abbreviation

NLP	Natural Language Processing
AI	Artificial Intelligence
WHO	World Health organization
ED	Empathetic Dialogue
LSTM	Long Short Term Memory
CNN	Convolutional neural networks
RNN	Recurrent neural network
HAN	Hierarchical Attention network
GloVe	Global Vectors for Word Representation
UI	User Interface
UX	User experience
JSON	JavaScript Object Notation
ML	Machine Learning
NLU	Natural Language Understanding
AIML	Artificial Intelligence Mark-up Language
CBT	Cognitive Behavioral Therapy
OS	Operating system

Abstract

World Health Organization statistics indicate that one out of every eight people suffers from mental illness. Due to the fear of stigma and social discrimination, they start being resilient and end up going through difficult situations alone. They fear criticism and start isolating them from friends, family and neighbours. The majority of individuals don't have access to effective care. If the issue isn't treated with care it can lead to serious mental problems such as it may cause depression, obsessive compulsive disorder, anxious or personality disorder. In order to overcome this problem, our mental health chatbot was created. Our study aims to provide efficient and essential care to the people with mental health concerns according to their needs and supplying the basic information regarding mental health problems through various sources. The proposed system eases the preliminary identification of mental health problem in the user by identifying and providing level-I therapeutical support for depression by employing conversational AI. This research utilizes technologies like Artificial Intelligence and its subfield Natural Language Processing (NLP) to provide an amicable environment for the user 24/7 and it can be integrated in cross platforms like iOS, android and windows etc. A knowledge base retrieval flow network is created with data which is stored globally through which the data is retrieved at the faster rate. After the user enters the chatbot they can converse with the bot initially else he/she also has the option of taking the assessment directly after entering the bot. Behind this process, sentiment analysis takes place which classifies the text into positive, negative or neutral. Once the score exceeds the range it was initially set then it will give the result accordingly. The dataset used in this study is AFINN-en-165 which already has pretrained list of words with the score. The program employed in the entire system is written through Flutter framework. This system allows the users to schedule appointment, to learn in detail about the terminologies of mental health and it provides resources for feel good activities like videos and music. Through this system they can candidly express their feelings to the conversational AI chatbot besides their insecurity. The Artificial Intelligence (AI) in turn provides them with chat support, acts as a bridge to understand the situations and suggests solutions depending on the level of mental health deterioration. We propose a fully automated and powerful first-level detection and support system for mental health.

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CHAPTER 1

INTRODUCTION

1.1. Background and Context

There is no doubt that mental health can also be defined as people's emotional, behavioral and cognitive well-being. If it gets disturbed it affects how the person behave, feel and act towards his personal and social life. In today's rapidly changing and hectic environment around the world makes everyone's mental health unstable. To possess a stabilized mental health becomes difficult due to unavoidable situations happening around us. In addition, due to lack of awareness terms such as 'depression', 'burnout', 'anxiety', 'stress', and 'trauma' are often taken for granted and even seen as fatal diseases. Hence, people become insecure and resistant towards sharing their feelings to others in order to avoid criticism and being judged. As a result of hiding their emotions, feelings and state of mind are overwhelmed and they end up being depressed because of lack of communication and trust with others which affects both their mental and physical health. A condition known as depression is a form of sadness which can also be referred as clinical depression. Individuals with depression may experience physical, cognitive and social changes in their life. Most of them mislead the term depression with sadness/ grief. Depression can also be defined as prolonged sadness or despair that lasts more than a few days. Each person would have undergone depression at some point of time. It is caused by various factors such as Genetics/Family history, biological factors such as deficits in brain chemistry, stress and medical conditions. Typically, the identification of this mental health issue will be done by physical exam, lab tests and psychiatric evaluation. The treatment for depression includes psychotherapy, right medications, psychoeducation, antidepressants and therapies for brain stimulation. A total of 6.44 percent of the world's population, or 5.16 billion individuals, will have internet access by 2023[1]. Through which we can tell most of the people are using internet worldwide and have smartphones and tablets which makes the process of accessing the chatbot easier. Since, the conversational AI utilizes continuous learning algorithms like Machine learning and deep learning they are regularly have with trainings to quickly respond to the user queries. The people feel more secure and comfortable to share their medical issues with the chatbot because of its non-judgmental quality.

1.2. Problem Statement:

Nowadays, people feel extremely insecure to talk about their mental health issues to their family, friends and loved ones because they are worried of being judged. They think that sharing their feelings may lead them into social stigma. They just stop communicating with their surroundings about their emotions and they start fearing of denial, discrimination and gossips. They start assuming that they couldn't get respect from their colleagues, fear of not receiving housing and losing jobs. Instead of seeking the medical care or sharing their thoughts/

feelings they continue hesitating their mental health issues. It is difficult for individuals to open up about mental health struggles specifically in the work area/office. In general, members worry the most about what their bosses or co-workers would think of them. Most often they forget that mental health is as important as physical health and end up in severe conditions like major depression, panic disorder and psychotic disorders. Hence, to make a better environment for the people to share their mental health concern this mental health chatbot was created which can be accessed virtually. Through this proposed system, they can communicate with the bot fearlessly and get effective care for their mental issues without the fear of being judged. A scarcity of mental health workers around the planet drives the application of technological advances, such as intelligent conversational agents, to serve people with mental health conditions[2]. If an individual needs to get medical assistance they have to book an appointment to the hospital to consult the healthcare professional. To book an appointment they have call the medical unit priorly which will be time consuming and more waiting time for each call made. Further, they have to consult the therapist in their available timings. So that's where our chatbot comes into play, with the help of chatbot the people can speak about their medical situation anywhere at anytime without any waiting time or appointment. They can get the initial level of guidance with the AI powered conversational chatbot. According to the article about the power of chatbot, it is mentioned that 75–90% of healthcare inquiries will be handled by chatbots by 2022[3]. Through this development of chatbot the people can get guidance at the right time. People still lack detailed knowledge about the mental health related issues and they misunderstand the terms related. Some of the traditional systems failed to address these main concept in their research which is addressed in this thesis research. Also, the studies didn't concentrate on bringing the useful resources in the model itself.

1.3.Organization of the report

This project mainly focuses on preliminary identification and providing therapeutical support of depression in mental health using conversation AI chatbot. The report contains six chapters that cover various implementation methodologies and details.

CHAPTER 1

An overview of the project is presented in this chapter, as well as the problem statement and the report's organization.

CHAPTER 2

This chapter contains literature survey which describes the already existing system and their advantages and disadvantages and methodologies they utilized

CHAPTER 3

This chapter includes the research design and system architecture with a detailed description and modules used

CHAPTER 4

This chapter deals with the methodology and therefore the flow of process is also explained.

CHAPTER 5

This chapter deals with system implementation in which code snippets and screenshots of output are depicted.

CHAPTER 6

This chapter entirely deals the conclusion and future works of the project

1.4.Summary

Developing therapy chatbots has various scopes in the healthcare fields. There is a severe lack of qualified medical professionals in the healthcare industry. If the patient needs to seek consultation they have to make an appointment priorly with the medical unit and have to wait for a longer period of time to get treated whereas through chatbots can provide one-to-one consultation for initial level of assistance. The conversational AI powered chatbot can assist the people round the clock anywhere and anytime. The chatbot also has various use-cases like scheduling appointments, locating nearby healthcare services, providing medical guidance and setting reminders etc. Therefore, this proposed study aims to create a knowledge base support chatbot which utilizes Thick Data Analytics to preliminary identification and provide therapeutic support for the depression in the user.

CHAPTER 2

LITERATURE SURVEY

2.1.Overview

The number of people experiencing depression has increased over the past years. The majority of patients are hesitant to seek counselling services from healthcare professionals. Hardly ten percentage of individuals only can avail treatment for clinical depression due to the scarce of useful assets and social disgrace connected with mental illness[4]. In general, virtual agents have two classifications based on their purpose. In the first case, the bot responds as per predetermined rules, while in the second case, an intelligent bot is employed[5].It's becoming quite common to use personal health chatbots as a novel and creative way to examine your functional wellbeing. They offer a practical way of receiving treatment for mental health conditions like stress, anxiety, depression, and addiction. In the evolutionary stages, chatbots only used text to communicate with users, hoping to give them insightful and human-like responses. It has become commonplace in society to use chatbots and conversational/virtual agents like Siri which is owned by Apple over the past ten years[6]. While chatbots are not the best means of providing original clinical support for consumers they can offer an excellent way to provide counselling for mental well-being, such as by showing users a wide range of techniques for self-care that they can utilize to help them improve their mental health. [7]. When a software successfully mimics a human conversation partner, it's believed to pass the distinguished Turing Test. ELIZA[8], PARRY[9], and ALICE[10] are just a few of the chatbots that were originally created to pass the Turing Test[11].In the research papers [12] [13], a moderate amount of research has been made on how to analyse the emotions of text that a user enters into a chatbot. Woebot[14] is one of the most popular and successful chatbot still currently available in the market. Woebot is a conversational AI chatbot that assists in mood monitoring and communicate like an personal assistant which uses cognitive behavioural therapy. Woebot simulates a friendly insightful conversation by incorporating natural language processing, psychological knowledge, excellent writing, and humour.

2.2. A Conversational Chatbot to treat people with major depression:CARO

The ultimate purpose of aim of creating CARO was treating individuals with major depression by conducting empathetic conversations between them and providing medical advices. CARO[15] has the capability to detect the context of the chat, its intents and underlying sentiment of the user using generator models. They have used two datasets for conducting empathetic dialogues and medical advices namely Medical Question Answering dataset[17] and Facebook AI Empathetic Dialogue[16].A total of 24,850 conversations with a labelled emotion are included in that dataset. They have collected a group of question-answer pairs that have been scraped off the web which contained medical advices from different forums of medical counselling, namely eHealthForum[18], WebMD, HealthTap etc.

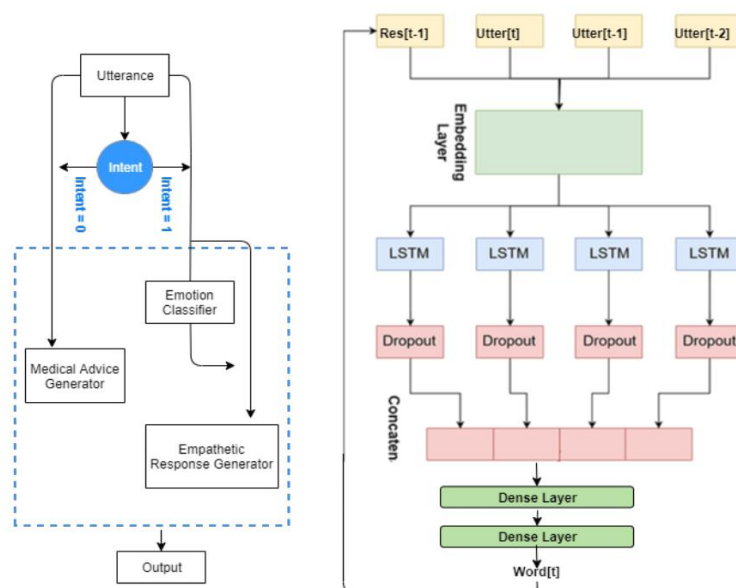


Fig.2.2.1. System architecture of CARO[4]

According to the above system architecture, it is obvious that two models have been used, one is for generating medical advice, and the other is for generating compassionate conversations. In order to place a chat message into one of the two models, the first thing it decides is whether the end-user is looking for medical advice or a regular conversation. The very first model, called the Generator of Empathetic Response, is made up of LSTM (Long Short Term Memory) that consists of 4 layers, concatenation and dense layers as seen in the figure. To keep the conversation in context, it takes into account the prior 2 utterances as well as the most recent user input. A chat is used to predict the sentiment of an existing user before the message is passed to the model. By incorporating the emotion of the present text alongside the 2 prior texts, an empathetic conversation can be created. Answer generators for medical questions and answers are instructed using medical Q/A datasets that follow the exact architecture of the system. They have used teaching forcing method for training purposes. For evaluation, they use BLEU and BERT score. They have achieved a higher accuracy on BLEU score 0.179 which was higher than the Facebook AI model. Also, they obtained a BERT score of 0.083. Further, they have also obtained more than 90% accuracy in terms of intent and emotion classifiers.

2.3. A Cognitive Behavioral Therapy to Treat Students with Depression using Intelligent Chatbot

In this research study[5], an intelligent therapeutic chatbot was proposed to relieve the students from different stages of stress by deploying emotional detection techniques. It takes input texts from the user in the chat and processes it with various methods. In the text, there is a list of emotions, including Joy, Shame, Happy, Disgust, Fear, Anger, Guilt and Sadness. Additionally, it determines the positivity and negativity percentages of each chat content based on the emotions. They trained and tested the text to identify emotions using three deep learning algorithms, namely Recurrent neural networks, Convolutional neural networks and Hierarchical Attention Networks. The chatbot's domain-specific technology used in the proposed methodology involves attempting to stop negative actions and replace them with more optimistic thoughts in an individual.

They basically concentrated on lowering the mental health illness like stress, depression on the young adults through their intelligent therapeutic chatbot. To determine their mental state and to overcome from such illness firstly they have to converse with the chatbot through that they tried to find the negativity percentage of the user through various flourishing technologies.

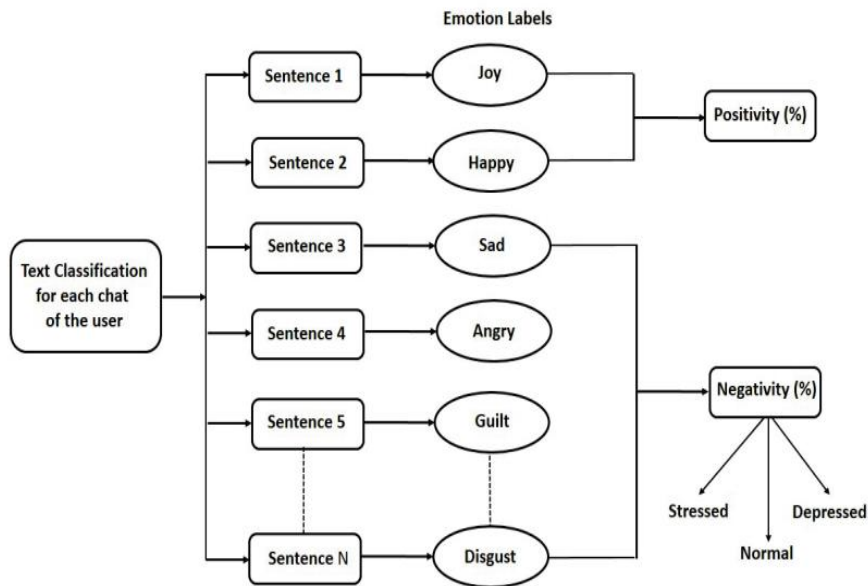


Fig.2.3.1. Identification of Mental State using user’s text[5]

The proposed system has been trained to recognise/classify a variety of emotions, including happiness, joy, guilt, fear, anger, sadness, disgust, and shame when text from users is delivered into the chatbot. A dataset called ISEAR[19] was used to identify emotions. It has 1542 emotional words and 7652 phrases.

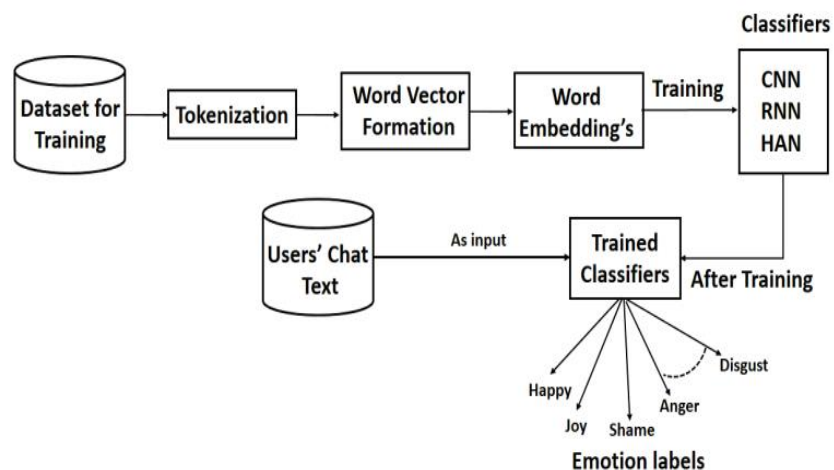


Fig.2.3.2. Testing and Training process[5]

There are three methods used in the training and testing process. They are Tokenization, Forming word vector and Embedding. In tokenization method, through the process of splitting an entire text into a series of sentences, the unsupervised algorithm can produce a model for collocations, words, abbreviation, and words that begin sentences. For it to work effectively, it must be pre-trained on as many plaintext examples as possible in the language it is designated to work in. That process is carried out using the tool like Punkt Sentence Tokenizer[20]. For generating word vectors, Global Vectors for Word Representation (GloVe) was used. According to statistical analysis of a corpus of global word-word cooccurrence data, training indicates output in interesting linear substructures of the word vector space. Using non-zero entries from its matrix, GloVe is trained using the frequency of words occurring altogether in a collective database. With the help of the tools in this package, co-occurrence statistics are automatically gathered and prepared for model input. Through the preprocessing steps the core training code is isolated and executed individually. This embedding method maps disjunct categorical variables onto continuous vectors. As mentioned earlier, embeddings are low-dimensional spaces that can be interpreted from high-dimensional vectors to low-dimensional planes. For reducing the complexity, embedding helps in various useful ways to reduce the dimensionality of categorical variables and they can represent it in the transformed space without changing its meaning.

For the purpose of classifying emotions from the text chat, three well-known classifiers such as HAN, CNN and RNN are employed. The network utilizes a variant of multilayer perceptrons with no cycles between nodes, requiring minimal preprocessing and its a kind of feed-forward type of deep learning neural network[21]. Each layer of convolution is observed by CNN when it is applied to text data, and the pattern may represent an N-gram word expression. RNN enables a time sequence to display dynamic temporal behaviour [22]. Additionally, it's a chain-like configuration of interconnected neural network key components. The Hierarchical Attention Network (HAN) has several components that make up its architectural framework, is made up of a number of aspects, such as, a sentence encoder, a word-level attention layer, a sentence-level attention layer and a word sequence encoder. [23]. The top - down approach of the document and the varied helpful words used in a sentence are two main insights that are aimed to be documented.

$$P(\%) = \frac{F(\text{joy}) + F(\text{happy})}{\text{Total no. of chat sentences}(n)} \quad (1) [5]$$

$$N(\%) = \frac{F(\text{sad}) + F(\text{angry}) + \dots + F(\text{disgust})}{\text{Total no. of chat sentences}(n)} \quad (2) [5]$$

After the emotions of every text have been categorised, the positivity and negativity ratio of every utterance are calculated using Equations 1 and 2. Based on the negative percentages calculated it categories their state of mental well-being into 5 divisions likely regular, mildly stressed, overstressed, slightly depressed, and extremely depressed.

Layer (type)	Output Shape	Param #
CNN)		
input_1 (InputLayer)	(None, 1000)	0
embedding_1 (Embedding)	(None, 1000, 100)	1157800
conv1d_1 (Conv1D)	(None, 996, 128)	64128
max_pooling1d_1 (MaxPooling1)	(None, 199, 128)	0
conv1d_2 (Conv1D)	(None, 195, 128)	82048
max_pooling1d_2 (MaxPooling2)	(None, 39, 128)	0
flatten_1 (Flatten)	(None, 128)	0
dense_1 (Dense)	(None, 128)	16512
RNN)		
input_1 (InputLayer)	(None, 1000)	0
embedding_1 (Embedding)	(None, 1000, 100)	1157800
bidirectional_1 (Bidirection)	(None, 200)	160800
dense_1 (Dense)	(None, 7)	1407
HAN)		
input_2 (InputLayer)	(None, 15, 100)	0
time_distributed_1 (TimeDist)	(None, 15, 200)	1318600
bidirectional_2 (Bidirection)	(None, 200)	240800
dense_1 (Dense)	(None, 7)	1407

Table.2.3.1. HAN, CNN and RNN results[5]

After tokenizing the dataset, they discovered that there were 11577 unique tokens. For RNN (bidirectional LSTM),HAN and CNN have used Glove 6B 100d, an average of 9786-word vectors, 48870-word vectors and 6118-word vectors, are procured which uses tokenization outcomes.

2.4. Digital Psychiatry

The above study's [24] objective aimed to develop a CBT system, recognised as a T-bot, that can fulfil users' informational and health needs. DADRM, which originally stands for Digitally Advanced Depression Relieving Machine, is the name given to their therapy chatbot. They have built a personal assistant which replicates as virtual therapist and focuses on hybrid attention that is the combination of psychiatry and technology with the help of Artificial Intelligence. Python is used as the foundational language in this study and can be assimilated with Android to function as a messaging service. T-bot classifies the depression into five different levels they are L-0 : Zero Depression, L-I: Slightly stressed, L-II: Highly stressed, L-III: Slightly depressed, L-IV: Highly depressed. The limitation of this study is it can be ran only in Android platforms it doesn't support multi-platforms integration.

2.5.A Chatbot for depressed people

In this research study[25],they employed an RNN LSTM encoder-decoder model to determine the current sentiment of end-users and determine which response the chatbot should provide. They have suggested a cross dialogue model that's applicable to daily speech rather than concentrating on particular tasks. They have built an intelligent chatbot with receives the users chat as the input message and replies appropriately by offering suggestions for reducing their stress. They have used Twitter sentiment analysis as the dataset for pre-processing the data. They have used Seq2Seq LSTM and RNN for training and testing purposes. They have conducted experiments using 200 dimensional vectors in Jupyter notebook using Pandas and Keras libraries which helped them in loading large dataset quickly. Through this model they have tried to handle vanishing gradient problem in RNN model.

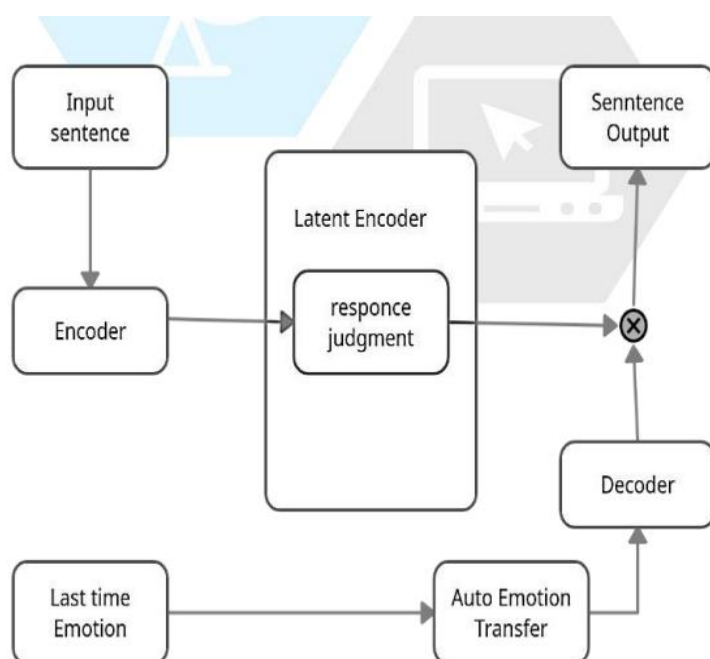


Fig.2.5.1.System architecture in the proposed system[25]

Model: "model"

Layer (type)	Output Shape	Param #
input_1 (InputLayer)	[(None, 22)]	0
input_2 (InputLayer)	[(None, 74)]	0
embedding (Embedding)	(None, 22, 200)	200
embedding_1 (Embedding)	(None, 74, 200)	200
lstm (LSTM)	[(None, 200), (None, 320800)	
lstm_1 (LSTM)	[(None, 74, 200), (N 320800)	
dense_2 (Dense)	(None, 74, 1)	201

Table.2.5.1.Classification of emotions using LSTM[25]

2.6.Summary

This chapter contains the detailed information and methodologies used in the existing/ conventional systems. It addresses the problems faced previously in terms of reducing the depression. Most of the systems lacks privacy in handling data. The details of how personal information collected through questionnaires are handled in some studies are not mentioned properly. There are some limitations and challenges in the traditional systems. Basically, most of the systems failed to teach the user what mental health generally means. Also, few systems are built as platform dependent in which the program runs particularly in that software system.

CHAPTER 3

RESEARCH DESIGN

3.1.Overview

The goal of the research study is giving the public an effective healthcare system. Through this proposed system the people feel secure towards sharing their feelings personally to a medical chatbot without the feeling of being judged. At first, it helps them to know whether they are affected by mental illness or not by conducting assessments and knowing their emotions through sentiment analysis. Based on the results, it recommends them to connect with the professional support if they are primarily identified with depression. They can schedule appointments with the therapist nearby their areas if they are really in need of care. Else, they can simply chat with the bot which provides them useful resources like articles, you-tube videos and music which helps them feel relaxed and calm. Most of the traditional systems fails to teach the people about the main concept of mental health topics. Through this study we make sure that each and every individual using this mental health chatbot can learn detailed concepts about the important terminologies linked with the mental illness which helps them in simplifying their thoughts about it. This encourages them to open up about their emotions, feelings and thoughts about their mental state to their friends or family. Even if they still feel insecure they can communicate it to the bot and know what are the further steps to take. Also, the existing systems just detects whether the user has the people have depression or not but they lacking in teaching them what are the other ways to ease the different levels of depression. If the person with slight burnout is utilizing the chatbot they just need some of the refreshing and relaxing resources in a single place so that they could get benefitted through it without wasting their time on things which is not important.

3.2.SYSTEM ARCHITECTURE EXPLAINED IN DETAIL

At first, the user enters into the user interface (login page) where they will be asked to type their login credentials. Additionally, it also contains the sign-up page to create a new account. Once the user gets in they will be able to see the homepage, they can communicate with the bot. The initial set of greeting messages pops at the start. Further, they can type their queries and the bot will give proper responses to the users. Behind, the bot calculates the sentiment score of each word entered by using sentiment analysis. Based on the score, it suggests them to either take an assessment of how their mental health is or asks them consult professional support. Moreover, it contains various helpful resources to the users to elevate the mood. To further understand this process detailed, the entire system is divided into various modules. The system design consists of five modules, they are UI/UX module, NLP module, Retrieval flow/Knowledge base network module, Sentiment analysis module and Resources module.

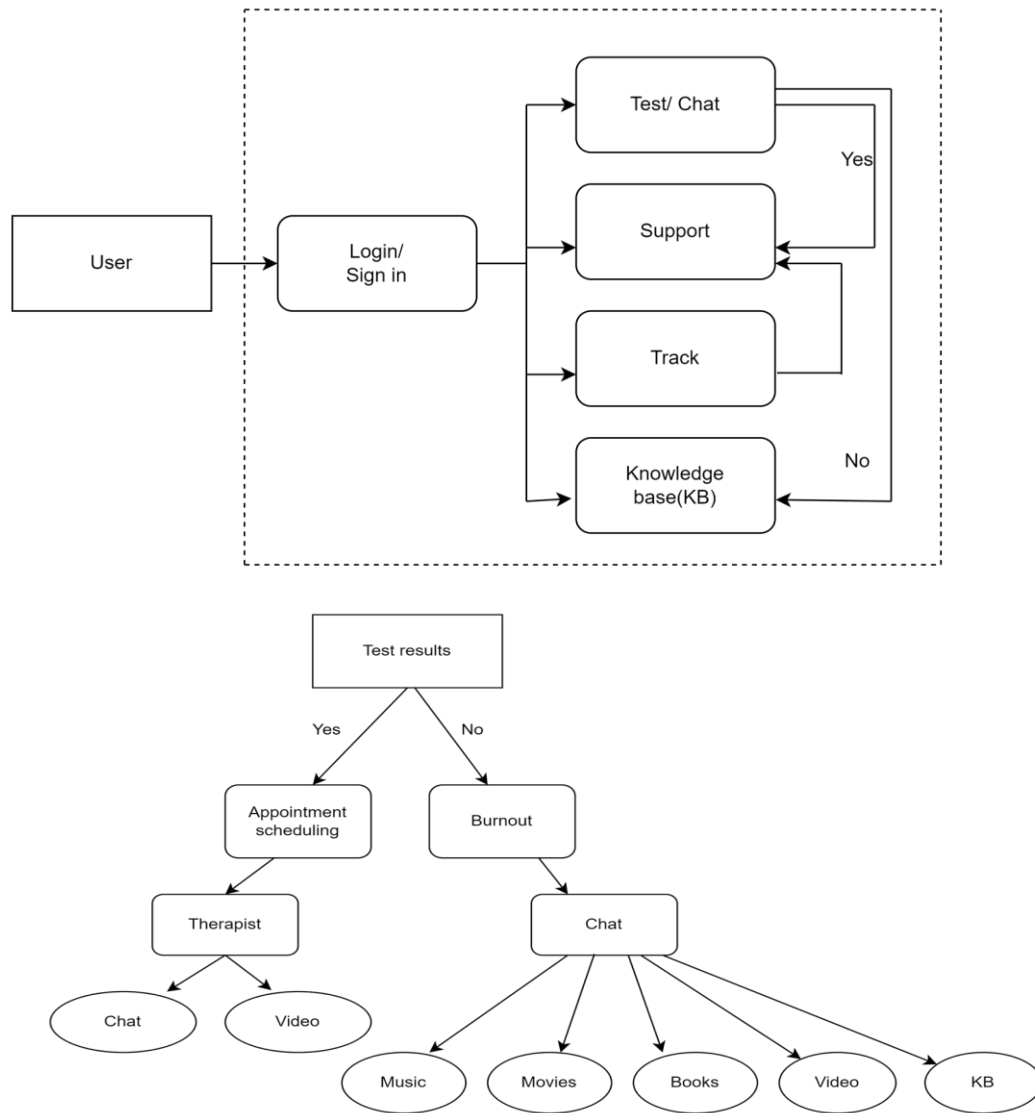


Fig.3.2.1. System architecture of proposed system

3.3. Modules explained:

UI/UX MODULE:

The UI/UX module acts as a user interface for the people who enters the chatbot. Basically, this module is created by using a free and open-source framework Flutter by Google which allows to connect multiple platforms through a single code base. Flutter mainly consists of various tools and widgets. It utilizes the dart language to write the code. The interface consists of various UI elements like buttons, sliders, message bubbles, text inputs and so on. This module provides a smooth transition between the modules built in it. Also, API calls acts as the bridge between two different components in the system. Thus, the query(input) raised by the user will processed in the backend and the answer(output) will be popped out in the display page.

The method for designing the interface, optimising navigation, and displaying meaningful features can be called user interface/user experience[26]. It incorporates layout and user acceptance elements to create user interfaces that are easy to use, rapidly get whatever users demand, work perfectly, are natural, and have a beneficial overall user experience. Additionally, the module takes into account personal choices, insights, and sentimental percentage when designing interfaces. A decent UX design improves usability, ease of access, and functionality while also allowing for enjoyable user interactivity with your app/website. Even while the terms UX and UI are frequently used interchangeably, they clearly refer to distinct concepts. One thing cannot survive with the absence of the other. The voyage a customer experience on a webpage, from the time they first arrive to the last move they make, is known as the user experience (UX). It's an extremely broad concept that considers both the response that are triggered by the experience as well as how an individual feels regarding the actual product. It is all about the feelings/emotions that has been shown by the customer while using any of the product and while experiencing it. Mostly its design-oriented and an user-friendly platform with interactive elements such as icons, buttons, typography, styles, themes, colour schemes, pictures, etc. is what is intended.

You can achieve better long-term results with an excellent UI/UX design. It assists with producing more prospective customers. If an good UI/UX is made for the company/business purposes in a nice way it benefits them in tremendous ways by providing more revenue. Design phase is confirming to be just as important as goods and prices as a crucial point of differentiation in the future as well as now.

The benefits of using UI/UX in our applications:

- It improves usability and provide better accessibility to the users
- Increase in brand recognition and awareness
- Making Fast and more captivating interface helps the app/website in tremendous ways
- Optimized design saves time and cost
- Enhances acquisition and retention

NLP MODULE:

NLP module can comprehend human language as it is in text or voice base[27]. NLP has been in existence for longer than 5 decades and has its roots in linguistics. It has countless practical uses in several fields, including business, search engines, healthcare, finance and marketing. By using artificial intelligence, natural language processing takes natural language input (for instance, English language), processes it, and then converts it into machine-understandable language to produce natural language output. A natural language processing system begins with the pre-processing of data and develops algorithms from it[28]. Text pre-processing is the initial step in developing models. The method involves preparing the data and cleaning it properly so that the machine can analyse it and gives clear result based how the data is processed. There are various steps involved, including Stop word removal, Tokenization, Stemming, Removing URL's, Lemmatization and punctuation words, Lower casing[29].The data/text is divided in to smaller units in tokenization process.

msg_lower	msg_tokenied
go until jurong point crazy available only in bugis n great world la e buffet cine there got amore wat	[go, until, jurong, point, crazy, available, only, in, bugis, n, great, world, la, e, buffet, cine, there, got, amore, wat]
ok lar joking wif u oni	[ok, lar, joking, wif, u, oni]
free entry in 2 a wkly comp to win fa cup final tkts 21st may 2005 text fa to 87121 to receive entry questionstd txt ratetcs apply 08452810075over18s	[free, entry, in, 2, a, wkly, comp, to, win, fa, cup, final, tkts, 21st, may, 2005, text, fa, to, 87121, to, receive, entry, questionstd, txt, ratetcs, apply, 08452810075over18s]
u dun say so early hor u c already then say	[u, dun, say, so, early, hor, u, c, already, then, say]
nah i dont think he goes to usf he lives around here though	[nah, i, dont, think, he, goes, to, usf, he, lives, around, here, though]

Fig.3.3. 1.Tokenization [29]

Words that are commonly used but don't contribute anything to the analysis are called stopwords. It does not make sense to use these words/phrases. Some set of stopwords includes namely i, my, me, myself, ours, we, our, ourselves, he, most, other, some, such, no, nor, not, only, you, you're, you've, you'll, you'd, your, yours, yourself, yourselves, own, same, so, then, too, very, s, t, can, will, just, don, should've, don't, should, now, d, ll, m, o, re, ve, y, ain, aren't, could, couldn't, didn't, didn't etc[29]. The comparison below shows the removal of stop words.

msg_tokenied	no_stopwords
[go, until, jurong, point, crazy, available, only, in, bugis, n, great, world, la, e, buffet, cine, there, got, amore, wat]	[go, jurong, point, crazy, available, bugis, n, great, world, la, e, buffet, cine, got, amore, wat]
[ok, lar, joking, wif, u, oni]	[ok, lar, joking, wif, u, oni]
[free, entry, in, 2, a, wkly, comp, to, win, fa, cup, final, tkts, 21st, may, 2005, text, fa, to, 87121, to, receive, entry, questionstd, txt, ratetcs, apply, 08452810075over18s]	[free, entry, 2, wkly, comp, win, fa, cup, final, tkts, 21st, may, 2005, text, fa, 87121, receive, entry, questionstd, txt, ratetcs, apply, 08452810075over18s]
[u, dun, say, so, early, hor, u, c, already, then, say]	[u, dun, say, early, hor, u, c, already, say]
[nah, i, dont, think, he, goes, to, usf, he, lives, around, here, though]	[nah, dont, think, goes, usf, lives, around, though]

Fig.3.3.2 Removing Stop words from the list of words[29]

The technique used to mitigate a word to its stem is recognised as stemming, which attaches to prefix, suffix or the origins of words known as "lemmas." The disadvantage of stemming is that it can make a word's root form unsuitable for use in English or change its meaning.

For example, the words like 'swimming', 'swim', 'swam' will be stemmed to 'swim'.

no_stopwords	msg_stemmed
[go, jurong, point, crazy, available, bugis, n, great, world, la, e, buffet, cine, got, amore, wat]	[go, jurong, point, crazi, avail, bugi, n, great, world, la, e, buffet, cine, got, amor, wat]
[ok, lar, joking, wif, u, oni]	[ok, lar, joke, wif, u, oni]
[free, entry, 2, wkly, comp, win, fa, cup, final, tkts, 21st, may, 2005, text, fa, 87121, receive, entry, questionstd, txt, ratetcs, apply, 08452810075over18s]	[free, entri, 2, wkli, comp, win, fa, cup, final, tkt, 21st, may, 2005, text, fa, 87121, receiv, entri, questionstd, txt, ratetc, appli, 08452810075over18]
[u, dun, say, early, hor, u, c, already, say]	[u, dun, say, earli, hor, u, c, alreadi, say]
[nah, dont, think, goes, usf, lives, around, though]	[nah, dont, think, goe, usf, live, around, though]

Fig.3.3.3. Example of Stemming[29]

In lemmatization, the end goal is to remove only the inflectional endings of words and return the base or dictionary form of the word through the use of a vocabulary and morphological analysis[30]. From the comparison given below, in stemming the word was ‘crazi’ and after applying lemmatization it changed to ‘crazy’. And that’s how the lemmatization works.

no_stopwords	msg_stemmed	msg_lemmatized
[go, jurong, point, crazy, available, bugis, n, great, world, la, e, buffet, cine, got, amore, wat]	[go, jurong, point, crazi, avail, bugi, n, great, world, la, e, buffet, cine, got, amor, wat]	[go, jurong, point, crazy, available, bugis, n, great, world, la, e, buffet, cine, got, amore, wat]
[ok, lar, joking, wif, u, oni]	[ok, lar, joke, wif, u, oni]	[ok, lar, joking, wif, u, oni]
[free, entry, 2, wkly, comp, win, fa, cup, final, tkts, 21st, may, 2005, text, fa, 87121, receive, entry, questionstd, txt, ratetcs, apply, 08452810075over18s]	[free, entri, 2, wkli, comp, win, fa, cup, final, tkt, 21st, may, 2005, text, fa, 87121, receiv, entri, questionstd, txt, ratetc, appli, 08452810075over18]	[free, entry, 2, wkly, comp, win, fa, cup, final, tkts, 21st, may, 2005, text, fa, 87121, receive, entry, questionstd, txt, ratetcs, apply, 08452810075over18s]
[u, dun, say, early, hor, u, c, already, say]	[u, dun, say, earli, hor, u, c, alreadi, say]	[u, dun, say, early, hor, u, c, already, say]
[nah, dont, think, goes, usf, lives, around, though]	[nah, dont, think, goe, usf, live, around, though]	[nah, dont, think, go, usf, life, around, though]

Fig.3.3.4.Lemmatization[29]

Converting the upper case in the first letter of the text to lower is commonly done in text pre-processing which is known as lower casing. It can be done according to the requirement of the model.

For example,

From the figure below we can clearly see that some of the words like Go, Available, Ok are processed to lower case in the msg_lower column: go, available,ok,cine, joking, cup etc.

clean_msg	msg_lower
Go until jurong point crazy Available only in bugis n great world la e buffet Cine there got amore wat	go until jurong point crazy available only in bugis n great world la e buffet cine there got amore wat
Ok lar Joking wif u oni	ok lar joking wif u oni
Free entry in 2 a wkly comp to win FA Cup final tkts 21st May 2005 Text FA to 87121 to receive entry questionstd txt rateTCs apply 08452810075over18s	free entry in 2 a wkly comp to win fa cup final tkts 21st may 2005 text fa to 87121 to receive entry questionstd txt ratetcs apply 08452810075over18s
U dun say so early hor U c already then say	u dun say so early hor u c already then say
Nah I dont think he goes to usf he lives around here though	nah i dont think he goes to usf he lives around here though

Fig.3.3.5. Lower casing[29]

In order to clean the noisy text data in the data preprocessing we need to first clear some data like word spelling, emojis, short words, special symbols, punctuation marks etc. Those list of punctuation marks include ‘!’#’\$%&’()*+,-./:;?@[\\]^_`{|}~’ etc.

v2	clean_msg
Go until jurong point, crazy. Available only in bugis n great world la e buffet. Cine there got amore wat...	Go until jurong point crazy Available only in bugis n great world la e buffet Cine there got amore wat
Ok lar... Joking wif u oni...	Ok lar Joking wif u oni
Free entry in 2 a wkly comp to win FA Cup final tkts 21st May 2005. Text FA to 87121 to receive entry question(std txt rate)T&C's apply 08452810075over18's	Free entry in 2 a wkly comp to win FA Cup final tkts 21st May 2005 Text FA to 87121 to receive entry questionstd txt rateTCs apply 08452810075over18s
U dun say so early hor... U c already then say...	U dun say so early hor U c already then say
Nah I don't think he goes to usf, he lives around here though	Nah I dont think he goes to usf he lives around here though

Fig.3.3.6. Removing punctuation[29]

In the current system initially the user provides his/her login credentials to begin the chatbot. Once they enter they find the homepage with the greeting messages pops up containing their username. Precisely, they can start the conversation with the chatbot by asking their queries. To build this particular module Dialog Flow NLP is used which is also created by Google. Primarily, the account will be created in Dialog Flow where the training of the data takes place through two methods Intent matching and Entity matching. It is easy, simple, convenient and less time consumption while compared to other NLP’s. The integration takes places by downloading the keys in JSON file format in Dialog Flow and using it in the code.

Retrieval Flow/ Knowledge base module

A knowledge base is a type of local data storage that stores questions and answers in the form of a class/json file. In this system, the data are stored globally in a file which will be called in the program in the form of classes. The data are stored in the name of collections, collectionfaq, faqs and faqanswer. It can also be described as the process of retrieving answers from the knowledge base and matching them to queries in order to finish the Question Answering process. This method aids for faster retrieval of the responses.

Sentiment Analysis module

The module is mainly concentrates on detecting the sentiment of the user. It is a text classification tool which utilizes the users input message and finds out the underlying sentiment linked with it by dividing their emotions into three categories such positive, negative, neutral. While chatting with the bot, the system initializes the analysis of the text by counting each words scores as mentioned in AFINN 165 dataset. It calculates the score of the input message by counter balancing all the positive and negative words every single time the text is entered. Once the score reaches -5 the bot pops up the message it requests that concerned person to either take a survey or to consult professional support since the score indicates major depression in that person. If the score reaches +5 then it will be considered that the person is normal.

Resources module

If the user feels burnout or little stressed then they can indulge in various activities included in the form of resources. They can go through the collection of mental health regarded questionnaires and answers to clarify their doubts regarding the terms of mental issues. They can watch videos which was selected purposely to motivate them to do yoga, workouts and arts to keep themselves stress free. Also, it has music podcast through which they can listen to the soothing music of nature which helps to calm down, feel refreshed and relaxed.

3.4.Summary

In the proposed system the people can find all the related stuffs about the mental well-being in a single chatbot starting from the clear explanations of the definitions/terms of mental health to the useful resources and activities like videos, workout and art therapies. There are several technologies used in this current system like the state-of-the-art technologies Artificial Intelligence and Natural Language Processing. This system consists of various modules and methodologies which is mentioned in detail in this chapter. Through this study the complete potential of Artificial Intelligence and Natural Language are used at its full extent to provide efficient and effective support system for mental health.

CHAPTER 4

METHODOLOGY

4.1.Methodologies explained in detail

Sentiment analysis

Sentiment analysis is the process of determining whether a sentence is positive, negative, or neutral. It incorporates machine learning (ML) and natural language processing (NLP) techniques to calculate scores for a phrase/sentence. Sentiment analysis aids data analysts in large corporations in understanding customer experiences, conducting refined market research, monitoring brand and product notoriety, and estimating public opinion[31]. Business organizations can use sentiment analysis to examine direct communications, such as phone calls, emails, chatbot interactions, and other conversations you have with customers. They can also examine online communications, like as remarks left by users on discussion boards, blogs, news articles, and review websites. By combining machine learning and artificial intelligence, text-analysis is initialized to analyze the text in the conversations made. It gathers the context and emotional content from the data(text).

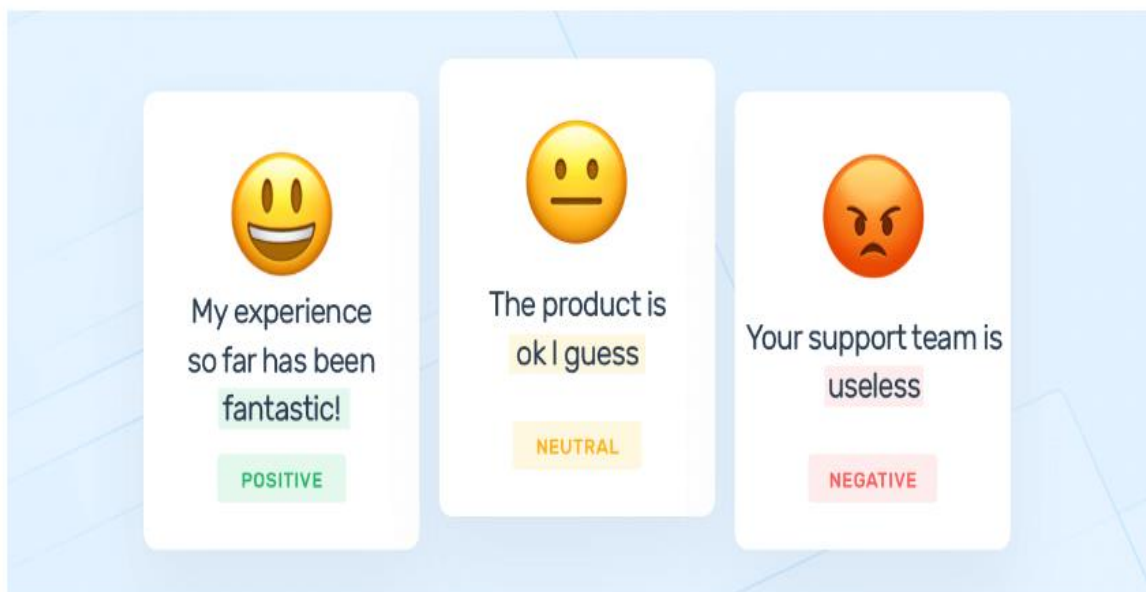


Fig.4.1.1.Sentiment analysis[32]

There are various kinds of sentiment analysis namely,

- Graded Analysis
- Emotion detection analysis
- Fine grained analysis
- Aspect based analysis
- Intent analysis

Sentiment analysis is used for several purposes like brand monitoring , improving customer support, tracking feedback from users, Product analytics and Market research monitoring. For instance, Consider Nike's recent advertising campaign featuring Colin Kaepernick, the divisive quarterback for the National Football League[33]. When Nike first revealed that Kaepernick would be a part of their upcoming marketing campaign, the general public's reaction was dominantly negative.

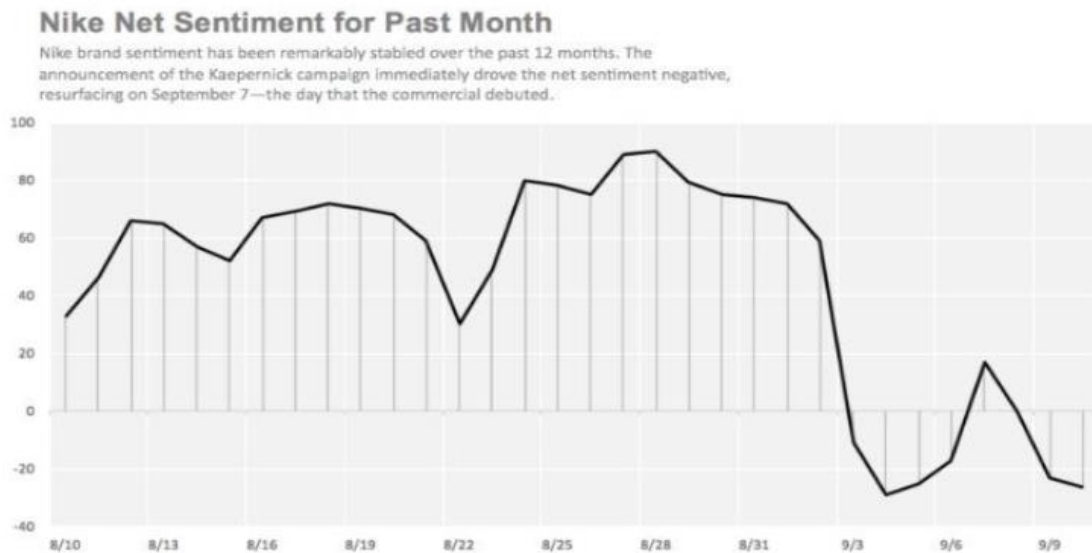


Fig.4.1.2.Sentiment analysis for Nike[33]

Besides the negative score there where also some positive bounds where found. After the release of the highly controversial advertisement, favourable sentiment for Nike actually increased. Nike's total sales increased by more than 31%[34].

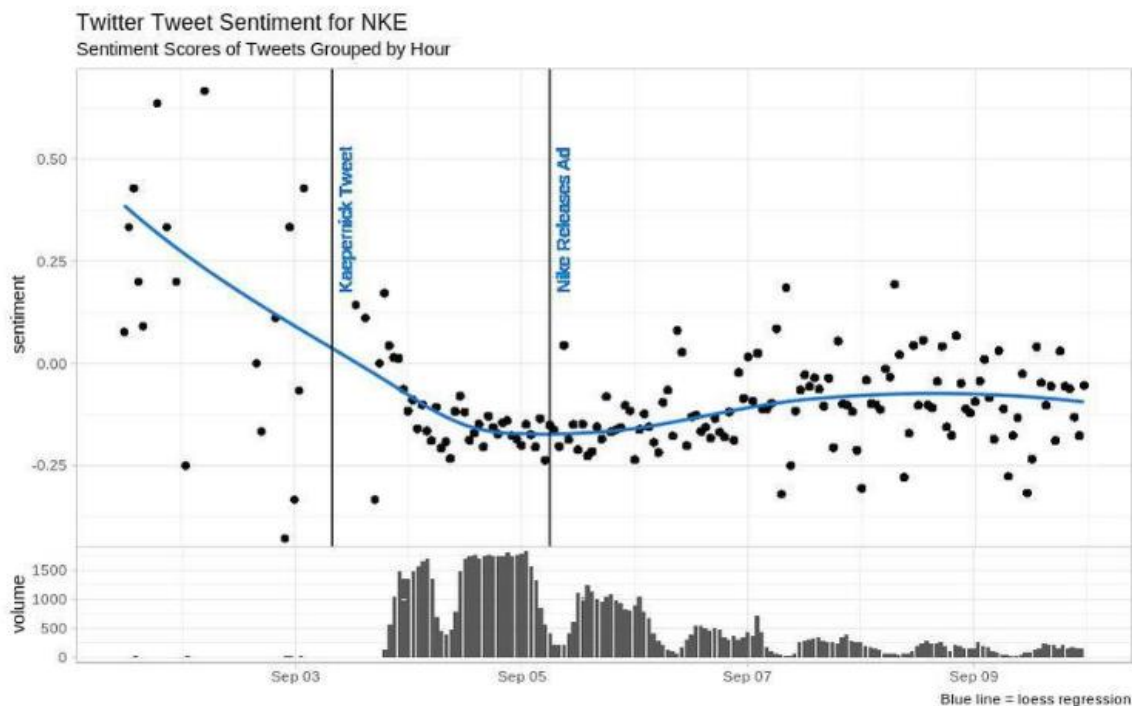


Fig.4.1.3.Sentiment score of Nike [33]

For social media monitoring, you can supervise any digital networks you have added for social sites with Hootsuite's remarkable dashboard.

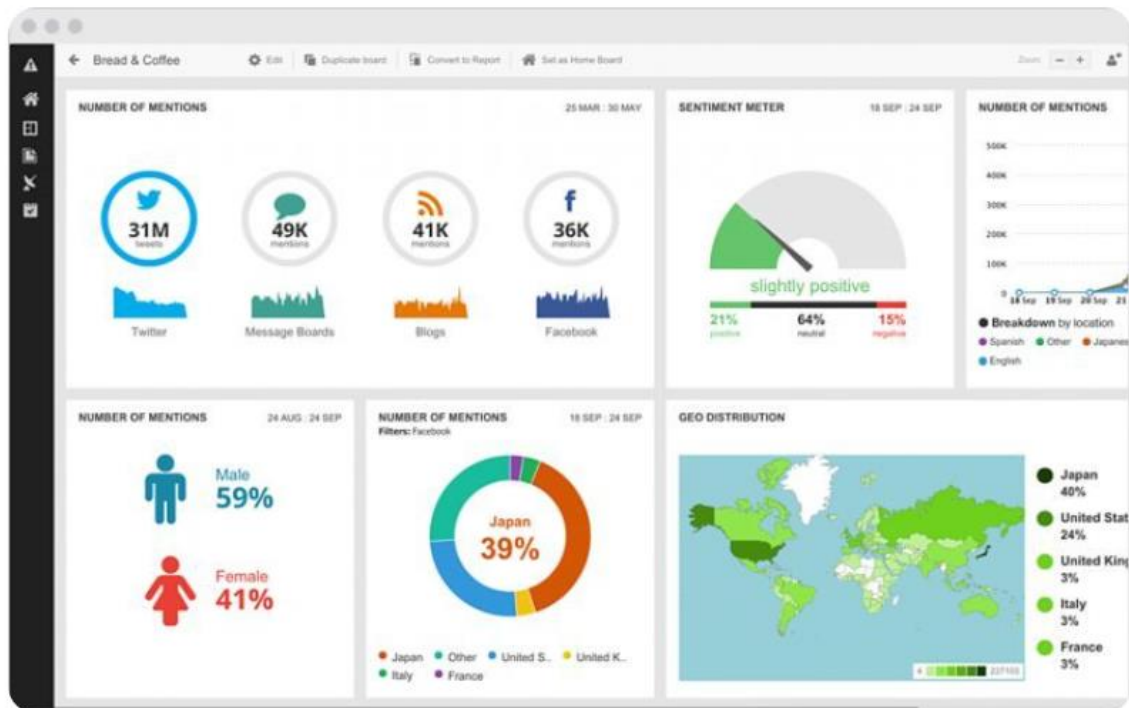


Fig.4.1.4. Hootsuite dashboard [33]

Machine Learning Approach, Lexicon-Based Approach, and Hybrid Approach are the three most frequently used approaches for sentiment analysis. Researchers are also constantly looking for more successful methods to carry out the assignment with greater precision and less computation.

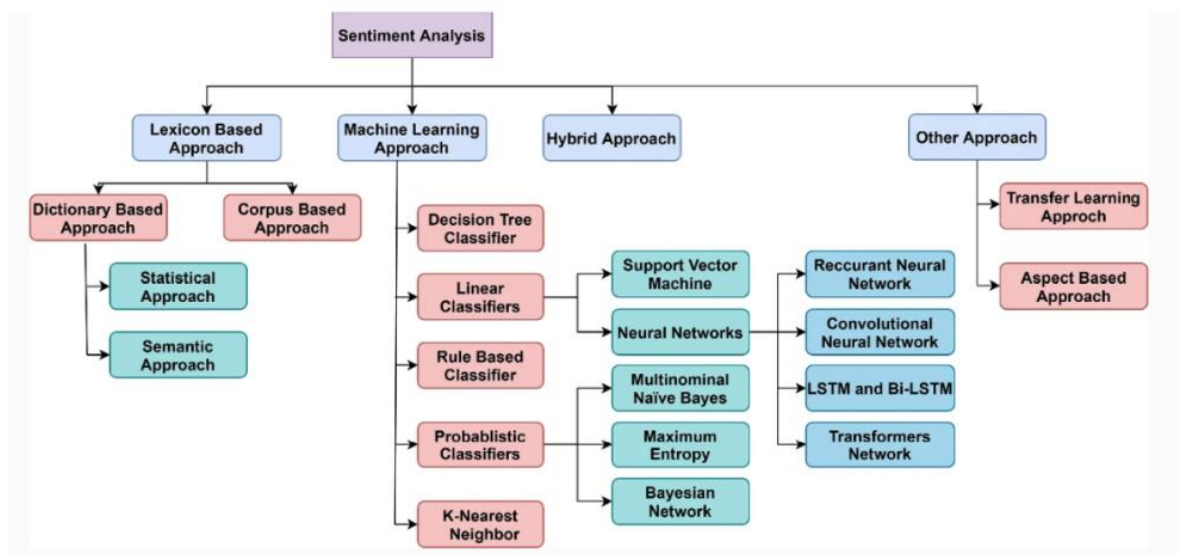


Fig. 4.1.5.Sentiment analysis classification techniques[35]

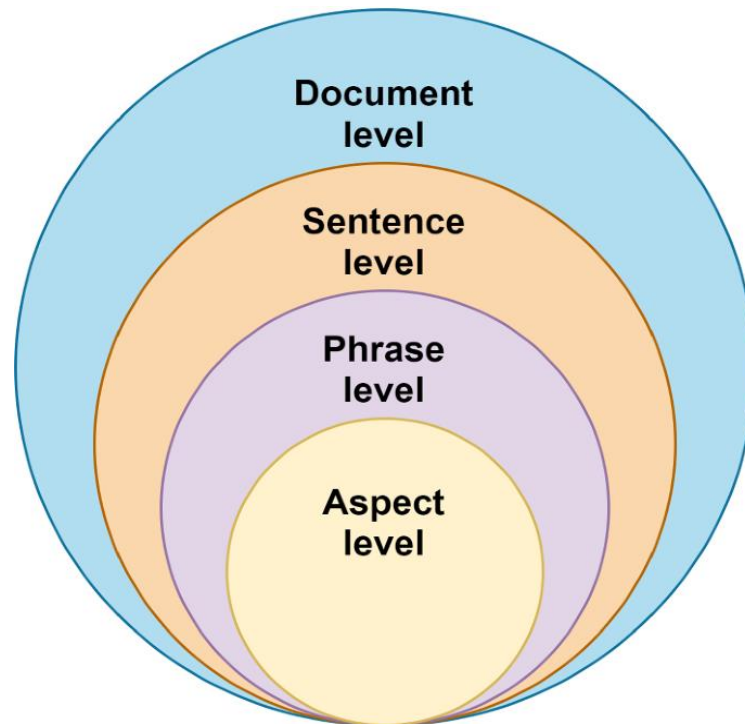


Fig. 4.1.6.Levels in sentiment analysis[35]

Limitations

With the aid of sentiment analysis tools, numerous texts can be quickly and automatically recognized and analyzed. However, irony and sarcasm, negations, funny texts, misconceptions and outright fabrications are some examples of the sorts of things that an individual would easily be able to recognize as being challenging for computer software to comprehend[36]. And failing to take these into account can drastically alter the outcomes. For example, it can be difficult for a computer to determine the line of thought being expressed in a tweet because they frequently include hashtags, emoticons, and links[37].

Chatbot

A computer program or piece of software known as a chatbot imitates human communication through text or voice interactions. People think of very big systems and complicated designs when it comes to AI, but the most powerful AI is the very basic chatbot. Conversations with users is the high priority module of every system and it has to be simple, sleek, dynamic and as accurate as possible and these can be easily attained with the help of chatterbots. Previously, the one and only way to request a software programme to respond to a question were by using a search tool or by completing a form. Majority of users started to utilize virtual agents to complete easy assignments in business-to-business(B2B) and business-to-consumer (B2C) [38].

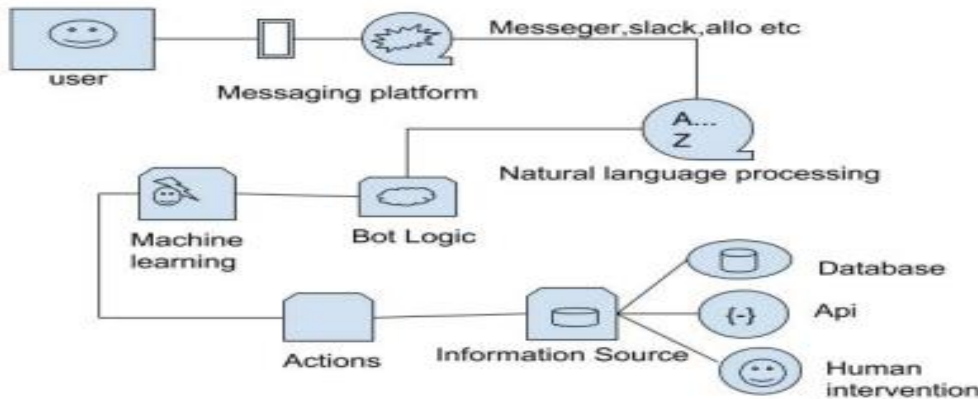


Fig.4.1.7.Working of chatbot[39]

In the olden days, virtual assistants were text-based and coded to respond to a small number of questions with previously written responses. When confronted with a complicated question or one that the developers had not even anticipated, they failed. They performed well with the interactive question answering session if they have already been trained on the data. Over the years, when Natural language processing and rule based approach was incorporated ,they started to interact more like an actual conversation. Nowadays, chatbots use several state-of-the-art technologies and techniques to decipher the need of the user while conversing. These technologies rely heavily on machine learning (ML) and deep learning, both features of artificial intelligence (AI) with subtle variations, to build ever-more-detailed databases of queries and answers[40].

Who's talking? Chatbots vs. conversational agents vs. virtual assistants

CHATBOT	CONVERSATIONAL AGENT	PERSONAL OR VIRTUAL ASSISTANT
<p>Operates on a single-turn exchange basis</p> <p>EXAMPLE A user asks, "Ok, Google, what's the tallest mountain in the world?"</p>	<p>Engages user in conversation to understand the nature of the problem</p> <p>A conversational agent is trained to ask a set of questions that can pinpoint the problem and potentially solve it</p> <p>EXAMPLE A customer states, "I'm having a problem with my car's GPS."</p>	<p>Exhibits its own personality and is uniquely associated with an individual user, similar to a human personal assistant</p> <p>Retains information associated with the user to provide contextualized answers</p> <p>Answers improve over time as virtual assistant learns more about the user</p> <p>EXAMPLES Can remind a user of meetings, check flight information and manage to-do lists</p>

Fig.4.1.8.Distinguishing Chatbots vs Conversational agent vs. virtual agents[38]

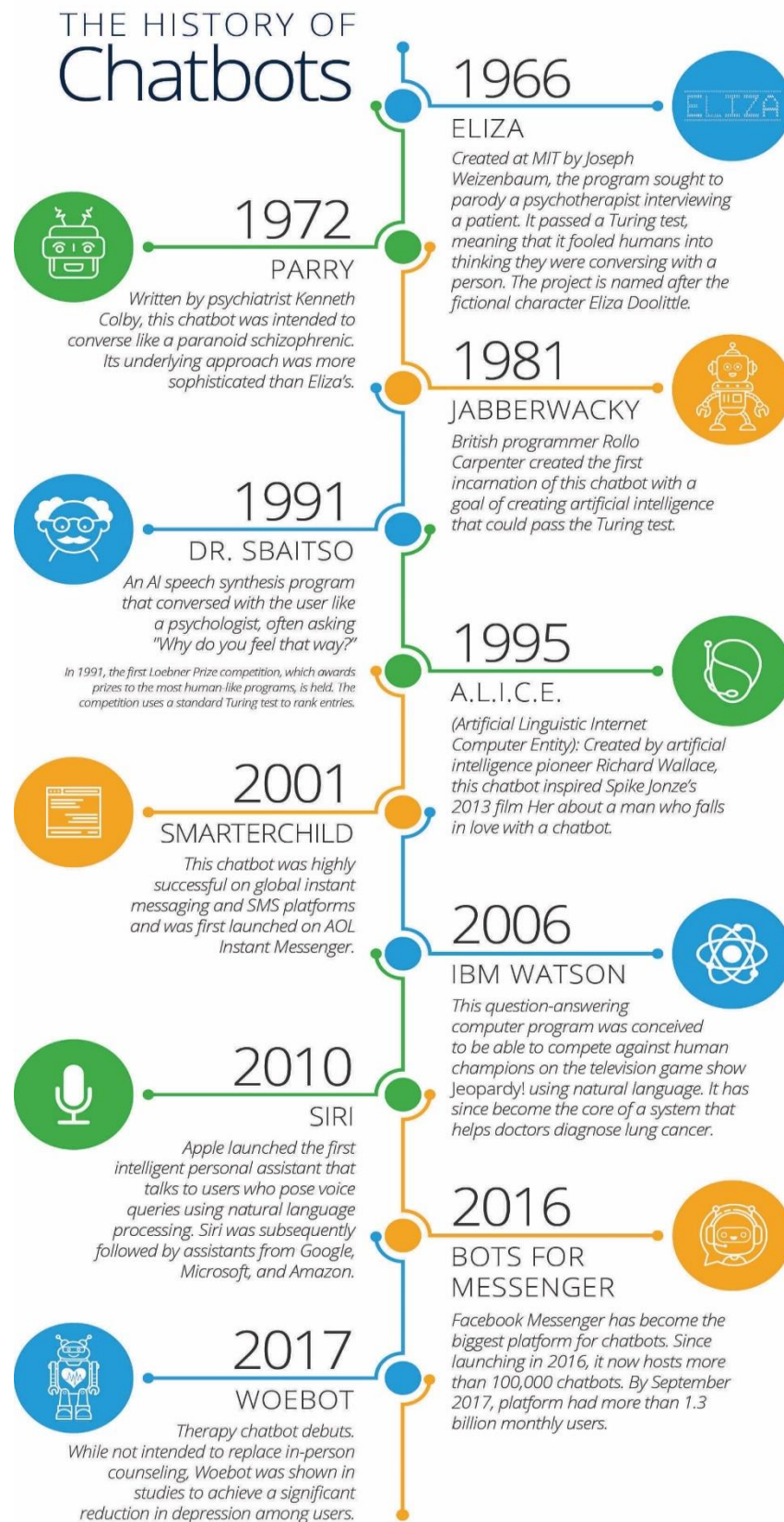


Fig. 4.1.9. History of chatbot[41]

In order to free up human agents for other duties, organizations are rapidly using chatbot-based ai systems to handle easy tasks. Early efforts to create software that could, at least temporarily, deceive a real person into believing they were talking to another person included chatbots like ELIZA and PARRY. It used 'pattern matching' and 'substitution methodology' to generate replies that give early users the impression that they are speaking with someone who understands what they have to say. The concept was to go through the user input messages, seek for specific keywords, and then retrieve the response if one was discovered. If it couldn't get the required answer then it still continuously keep asking the user further details to keep the conversation active.

ELIZA: What's on your mind today? Please let me know your opinion.
YOU: About family.
ELIZA: I see.
YOU: I think Sazae's family is good.
ELIZA: What caused you to feel that way?
YOU: Because the family members believe in themselves.
ELIZA: What other reasons might there be?
YOU: Well, I don't know.
ELIZA: I'd like to know more about your opinion.
YOU: I don't like my family so much.
ELIZA: That is quite interesting.
YOU: Yeah.
ELIZA: I'd like to know more about your opinion.
YOU: My family members aren't friendly, so I can't talk with them.
ELIZA: I see.
YOU: Do you have family?
ELIZA: Why do you think that?
YOU: I don't know who you are.
ELIZA: Why do you ask?
YOU: I'm sorry.
ELIZA: That's okay. Please continue.

Fig. 4.1.10. Example of conversation with Eliza[42]

ALICE:

Richard Wallace introduced ALICE in 1995. An AIML file was created to store pattern knowledge for bots and is comparable to an XML file. The following describes the three different types of AIML categories:

Atomic category

Atomic category is a kind of AIML category which is used to find an exact match[42].

```
<category>
<pattern>What is your name</pattern>
<template>My name is Nick</template>
</category>
```

Default category

It is a kind of AIML category where any input can be matched using a wild character like *[42].

```
<category>
<pattern> What is * </pattern>
<template>It is my name </template>
```

Recursive category

It's employed to refer to a recursion using special tags in order to persuade the user to be more specific[42].

```
<category>
<pattern>Do you know what the * is</pattern>
<template>It is my name
<srai>What is<star/></srai>
</template>
</category>
```



Fig. 4.1.11.Example of conversation with ALICE[42]

WOEBOT:

A psychotherapy chatbot named Woebot assists its users in tracking their moods and learning more about themselves. A group of Stanford psychologists and AI specialists founded it in 2017. In short daily conversations of no more than 10 minutes, Woebot asks its user how they are beginning to feel and how their lives are progressing (maximum). Natural language processing, considerate writing, a good sense of humour, and psychological knowledge, particularly in Cognitive Behavioral Therapy[43] are combined to accomplish this. Following the storage of all text and emojis, it then begins to recall earlier conversations to make its queries and responses more precise. The bot encourages mental health by monitoring its user's feelings and wants and, when suitable, curating videos and other helpful tools over chat.



Flutter

Flutter is an open source framework which can build top-notch and beautiful apps which runs on all cross-platforms like Android, iOS and Windows etc. It is created by Google and written in Dart language. It can be operated through a single code base. We ought to code in two different languages and two different frameworks in order to create an application that works all OSs. To overcome this situation we need to find a framework which does the work and that's where flutter comes into play which can run on different platforms like web, android and ios. Through its simple and fast performing technology its easy to build applications with exquisite user interfaces. Flutter also provides a variety of ready-to-use widgets (UI) to build a contemporary application.



Features of flutter

- Agile and simple development
- Open source
- Single Language
- Beautiful interfaces
- Various widget option
- Reactive framework
- Easy initial setup

Advantages

- Dart has a substantial library of software packages that you can use to increase the functionality of your programme.
- Single code base
- Less testing is required for Flutter
- Rich documentation

Disadvantages

- Developers need to learn a new language called Dart
- Modern frameworks make every effort to keep logic and user interface apart, but Flutter blends them together.

Flutter's main concept basically contains the Widget. Widgets are essentially user interface elements used to design the application's UI. The application is a leading widget, and the user interface (UI) is created using one or more widgets that were themselves created using widgets from its children. Flutter supports state maintenance where it contains two widgets namely Stateful widget and Stateless widget.

In the hierarchy of widgets,

- MyApp is a user-created widget that was constructed using MaterialApp, a native Flutter widget.
- Using Scaffold, a different native flutter widget, MyHomePage is constructed.
- The two properties of Scaffold are AppBar and appBar
- Child refers to the actual content which is also the property of Center.

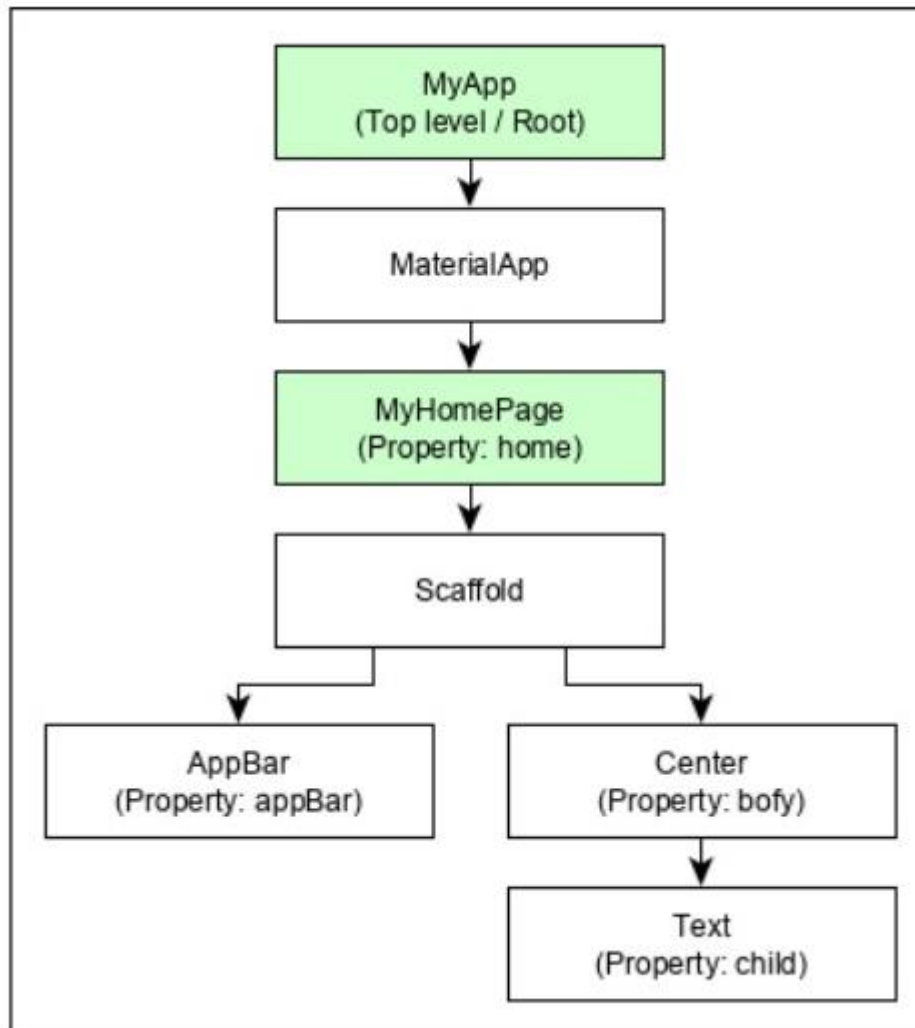


Fig. 4.1.12.Hierarchy of widgets[44]

4.2.Methods used in proposed system

Primarily, the user has to create an account with his/her email id through the sign up option in the app. Then, they are supposed to enter their login credentials like email-id and password. The basic part of chatbot is the user interface which provides the user with easy transitions and connectivity between the modules.75–90% of healthcare and banking inquiries will be handled

by chatbots by 2022[3].The implementation of chatbots in various industries has increased recently, including those that deal with education, entertainment, marketing, support systems and health care units [45].

In this thesis, both the frontend and backend technology is done through Flutter framework. With this technology, programs are compiled in real time using computer code instead of conventional code[24]. The code for flutter framework is written in Dart language. Flutter basically consists of various widgets which is easy to modify and customize at any point of time. Utilizing Flutter helps in reducing test time , writing code is faster and cost effective. Due to its multiple integration property Flutter was chosen and implemented for this thesis research. Since, Flutter and Dialogflow was created by Google the connectivity became much easier.

Through the conversation, the end-user shares their stories and feelings without any insecurity which can be called as Thick data. Then those data are analyzed in the backend. Fundamentally, thick data is a qualitative approach which obtains feelings, behavior, emotions, social and contextual data of the user in their daily lives. The term ‘Thick data’ was employed by global tech ethnographer Tricia Wang to foster integrative research approaches [46]. According to Wang, the thick data helps in revealing the depths and meaning behind the stories of the users. These data are gathered by conducting various surveys, questionnaires, observations and interviews among the people to know more deep about their emotions. In the proposed system, the thick data of the user is collected by conducting a survey to detect whether the person is affected by mental health issue or not.

Sentiment analysis is a fascinating new topic of research in AI that integrates psychology, machine learning, and natural language processing[47]. Automatic methods of polarity (positive, negative, and neutral) detection in texts have greatly expanded in tremendous quantities as a result of the burgeoning of enormous amounts of opinions in e-forms on the web, on digital platforms, and on articles. Through social media networks like Twitter, Reddit, Tumblr, and Facebook, millions of individuals started sharing their opinions and points of view on everyday life issues that either directly or indirectly affect them in this era of microblogging[48]. By using sentiment analysis technique we can clearly know the emotions of the user expressed in the text message. To analyze and process the thick data in detail this study uses sentiment analysis which calculates the emotion of the user based on AFINN dataset.

English words with valence ratings of minus five (negative) to plus five (positive) are listed in the AFINN lexicon[49]. Finn Arup Nielsen labelled the words manually between 2009 and 2011. The earliest version of the AFINN list are AFINN -96 and AFINN-111. In 2009, AFINN 96 list was created with 1468 entries and AFINN 111 list was created with 2477 entries in the year of 2011. The recent version of the word list is AFINN 165 which contains 3382 entries since 905 entries were additionally added to AFINN 111 and two entries were modified in the word list. In this thesis, AFINN 165 word list was used to determine the sentiment of the user. Whenever the user converses with the bot, the sentiment analysis detects the score and if the score reaches negative the conversation will be paused and the bot pops up the message to

either take an assessment or to consult professional and it directs them accordingly with their choices.

The input text which user enters in the textfield hits the dialog flow system which is trained according to the needs of the user and also it contain various informatic topics about mental health. DialogFlow is a platform created by Google services and it is operated on Google cloud platform. It mainly helps in building conversational applications which runs on omnichannel platforms and enables multiple language support. It can be deployed in various platforms such as Google assistant, Alexa, Facebook messenger and Slack etc., It is simple, highly reliable and easy to integrate in any platforms.

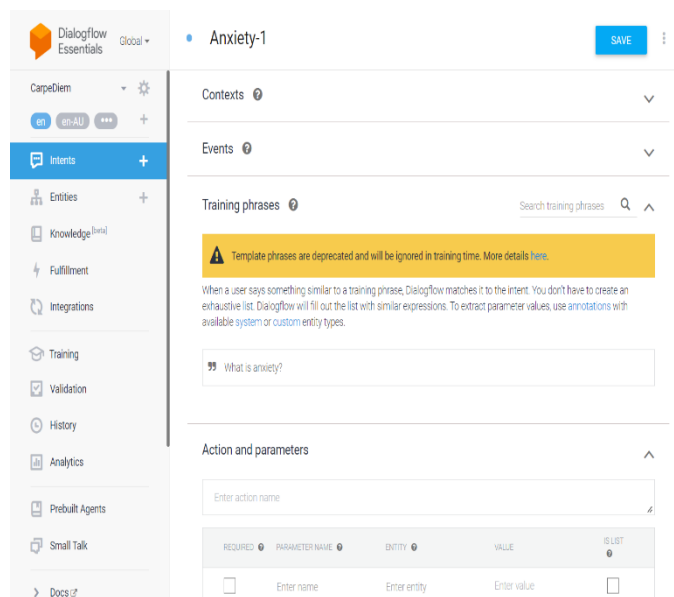


Fig.4.2.1. Dialogflow's Intent creation with traing phrases

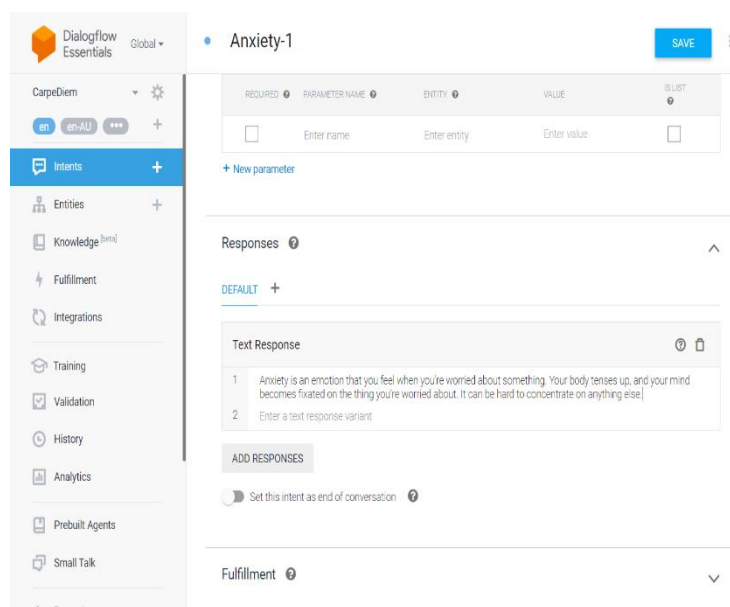


Fig.4.2.2. Dialogflow's Intent creation with responses

The key components of Dialogflow includes intents, entity, response, context, user says, invocation and fulfillment request. Dialogflow has agent which is designed essentially to make various kinds of conversations according to the needs of our system. In this thesis, dialogflow agent is created and trained. Then Intent is employed for training purposes. The intent contains the training phrases where the queries are entered as user expressions and its related responses are added to it. This complete process happens in the Dialogflow console.

4.3.Summary:

This chapter contains the methodologies and modules involved to implement the mental health chatbot. This chapter discusses about methodologies in detail by its definition, use cases, advantages , disadvantages and features etc., In this study, the chatbot is utilized for mental health wellness purpose which helps the user in abundant ways by providing friendly circumstances to share his/her stories. To provide smooth transition within the chatbot all these modules are created which is simple and easy to use.

CHAPTER 5 IMPLEMENTATION

5.1.Implementation

This chapter contains the implementation of the entire project with some of the main code snippets and the result screenshots. The figure below indicates all the essential libraries for this chatbot. At the starting of each program files all necessary libraries will be called according to the requirements.

```
import 'package:bubble/bubble.dart';
import 'package:dart_sentiment/dart_sentiment.dart';
import 'package:dialogflow_flutter/googleAuth.dart';
import 'package:dialogflow_flutter/dialogflowFlutter.dart';
import 'package:dialogflow_flutter/language.dart';
import 'package:flutter/material.dart';
import 'package:circular_menu/circular_menu.dart';
import 'package:mentalhealthchatbot/consultants.dart';
import 'package:mentalhealthchatbot/setsofcollection.dart';
import 'package:mentalhealthchatbot/survey.dart';
import 'audiomanager.dart';
import 'videos.dart';|
```

Fig.5.1.Code snippet of libraries

The figure below indicates all the important dependencies used for the bot and these are stored in pubsec.yaml files which contains all the metadata of the project.

```
dependencies:
  flutter:
    sdk: flutter
  url_launcher: ^6.0.4
  carousel_slider: ^4.2.1
  smooth_star_rating: ^1.1.1
  youtube_player_iframe: ^2.0.0
  connectivity_plus: ^2.0.2
  just_audio: ^0.9.15
  audio_video_progress_bar: ^0.9.0
  assets_audio_player: ^3.0.6
  http: ^0.13.4
  syncfusion_flutter_pdfviewer: ^20.4.43
  audioplayers: ^0.20.1
  circular_menu: ^2.0.1
  dialogflow_flutter: ^1.0.0
  bubble: ^1.2.1
  dart_sentiment: ^0.0.9
  syncfusion_flutter_calendar: ^20.4.49
  rflutter_alert: ^2.0.4|
```

Fig.5.2.Code snippet of flutter dependencies

The initial page the user visits is the sign-in page which contains the input text field for email and password. If the person is new to the system, then he/she can create an account to activate the chatbot. For account creation, they are supposed to fill specific fields like Name, Email and create their own password. If they are existing user, they can enter their credentials to chat with the mental health chatbot.

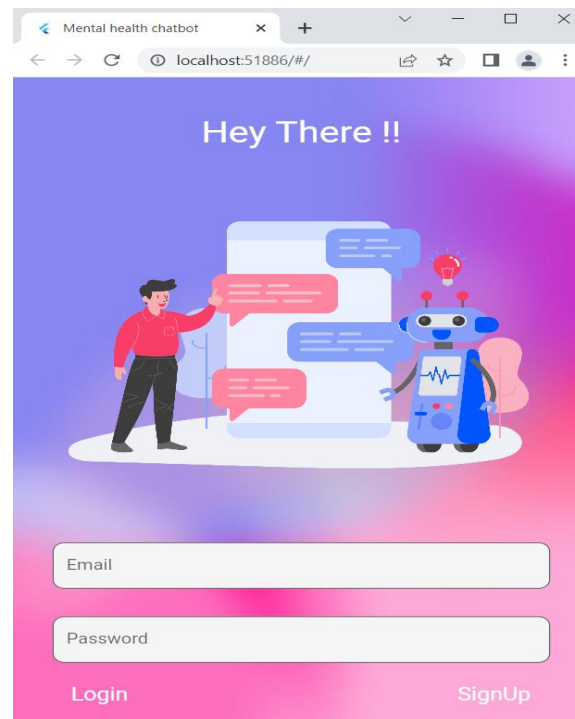


Fig.5. 3. Sign in page

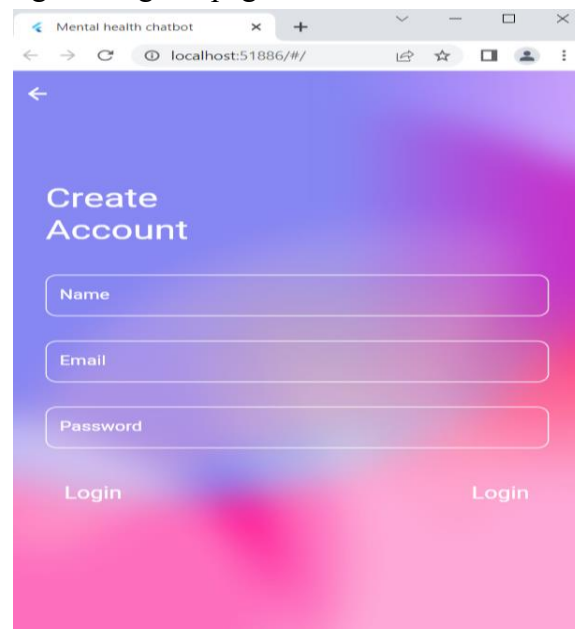


Fig.5.4. Account creation page

At first, the user views the homepage which consists of all the essential elements one needs to chat with the bot. Basically, they witness the initial greeting messages which has already been programmed. It has the input text field where actually the user types his/her queries to the

chatbot. In menu bar, they have two options, QNA and Professional support. If they tap the floating action button they can view various resources. Each button navigates to its individual page.

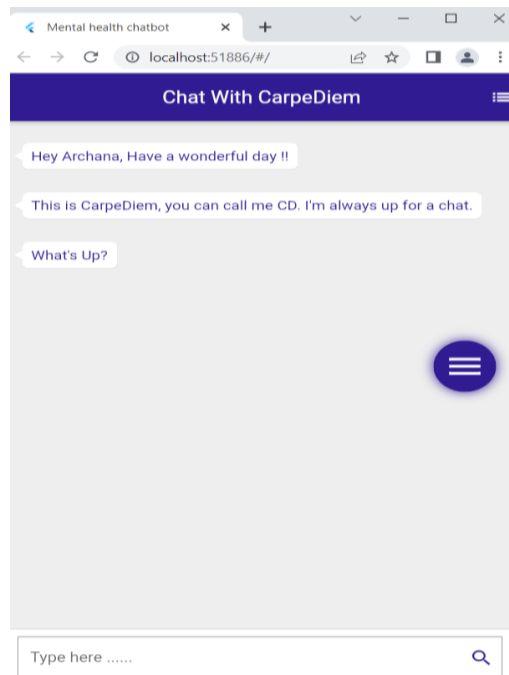


Fig.5.5.Homepage with floating button

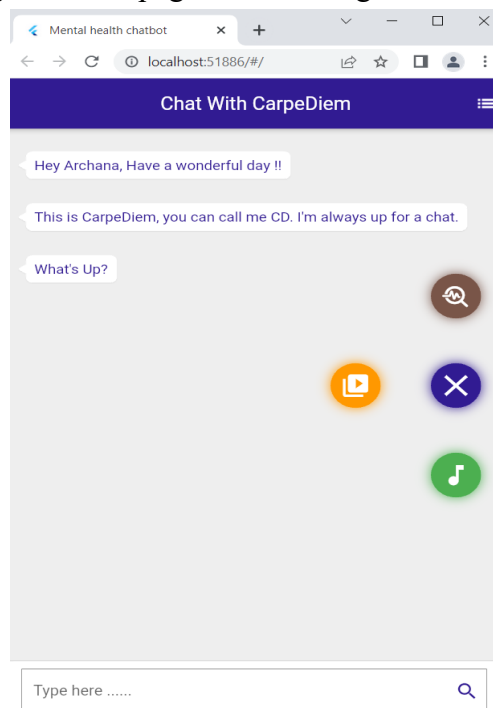


Fig.5.6.Homepage with expanded floating button

```
floatingActionButton: CircularMenu(  
  alignment: Alignment.centerRight,  
  toggleButtonColor: Colors.deepPurple.shade900,  
  items: [  
    CircularMenuItem(  
      icon: Icons.music_note,  
      color: Colors.green,  
      onTap: () {  
        setState(() {  
          Navigator.push(context,  
            MaterialPageRoute(builder: (context) => Player()));  
        });  
      }),  
    CircularMenuItem(  
      icon: Icons.video_collection,  
      color: Colors.orange,  
      onTap: () {  
        setState(() {  
          Navigator.push(context,  
            MaterialPageRoute(builder: (context) => SetsofVideos()));  
        });  
      }),  
    CircularMenuItem(  
      icon: Icons.troubleshoot_rounded,  
      color: Colors.brown,  
      onTap: () {  
        setState(() {  
          Navigator.push(  
            context,  
            MaterialPageRoute(  
              builder: (context) => SetsofCollection()));  
        });  
      }),  
  ],  
);
```

Fig.5.7.Code snippet of Floating button

If the person click the collection page, they will be directed to set of collection page which contains every collections in a single container. The user can get to know about all the terminologies linked with the mental health through a single tap. The blocks hover whenever the user slides through this page.

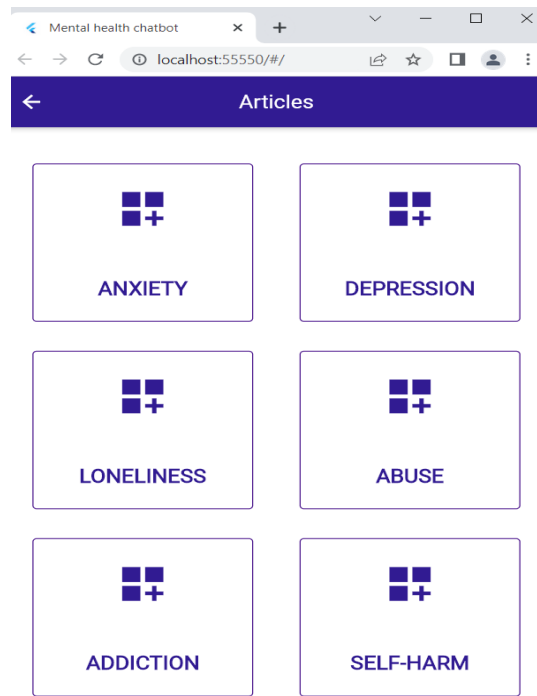


Fig.5. 8.Set of collection

```

setofkb() {
  UIList.add(Padding(padding: EdgeInsets.all(16.0)));
  for (var i = 0; i <= globals.collections.length - 1; i++) {
    if (i + 1 != globals.collections.length) {
      UIList.add(
        Row(
          mainAxisAlignment: MainAxisAlignment.spaceAround,
          children: [
            SizedBox(
              height: 175,
              width: 200,
              child: OutlinedButton(
                style: ButtonStyle(
                  side: MaterialStateProperty.all(BorderSide(
                    color: Colors.purple.shade900,
                    width: 1.0,
                    style: BorderStyle.solid)),
                  backgroundColor: MaterialStateProperty.resolveWith<Color>(
                    (Set<MaterialState> states) {
                      if (states.contains(MaterialState.hovered))
                        return Colors.deepPurple.shade900;
                      return Colors.white;
                    }
                )),
                iconColor: MaterialStateProperty.resolveWith<Color>(
                  (Set<MaterialState> states) {
                    if (states.contains(MaterialState.hovered))
                      return Colors.white;
                    return Colors.deepPurple.shade900;
                  }
                ),
                foregroundColor: MaterialStateProperty.resolveWith<Color>(
                  (Set<MaterialState> states) {
                    if (states.contains(MaterialState.hovered))
                      return Colors.white;
                    return Colors.deepPurple.shade900;
                  }
                ),
              ),
            ),
          ],
        ),
      ),
    ),
  ),
}

```

Fig.5.9.Code snippet of Set of collection


```

Container(
  child: Row(
    mainAxisAlignment: MainAxisAlignment.min,
    children: [
      StreamBuilder<bool>(
        stream: _audioPlayer.shuffleModeEnabledStream,
        builder: (context, snapshot) {
          return _shuffleButton(context, snapshot.data ?? false);
        },
      ),
      StreamBuilder<SequenceState?>(
        stream: _audioPlayer.sequenceStateStream,
        builder: (_, __) {
          return _previousButton();
        },
      ),
      StreamBuilder<PlayerState>(
        stream: _audioPlayer.playerStateStream,
        builder: (_, snapshot) {
          final playerState = snapshot.data;
          return _playPauseButton(playerState!);
        },
      ),
      StreamBuilder<SequenceState?>(
        stream: _audioPlayer.sequenceStateStream,
        builder: (_, __) {
          return _nextButton();
        },
      ),
      StreamBuilder<LoopMode>(
        stream: _audioPlayer.loopModeStream,
        builder: (context, snapshot) {
          return _repeatButton(
            context, snapshot.data ?? LoopMode.off);
        },
      ),
    ],
  ),
);

```

Fig.5.12.Code snippet for music page

At last, the video page where the user can check videos related to their needs. It contains workout videos to curb depression, feel good movie suggestions, music, art therapies, yoga videos which are specifically designed for the people suffering from mental health issues to keep them engaged in activities throughout which makes them feel better and relaxed. This leads to increase in their positive thoughts, ideas and feel relaxed.

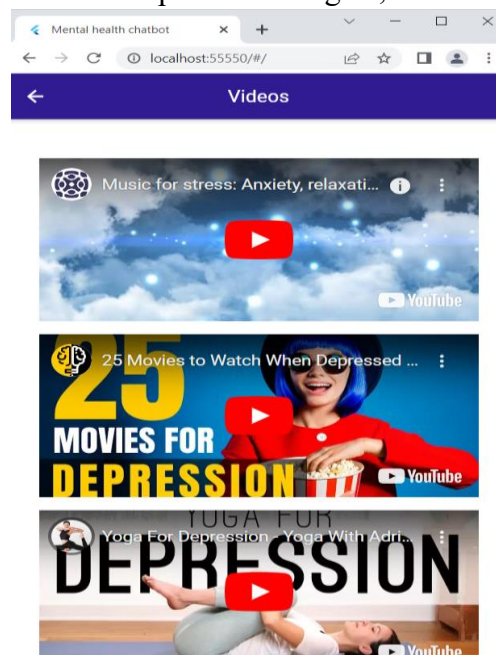


Fig.5.13.Video page


```

setofkb() {
  UIList.add(Padding(padding: EdgeInsets.all(16.0)));
  UIList.add(
    Padding(
      padding: EdgeInsets.fromLTRB(24.0, 8.0, 24.0, 8.0),
      child: SizedBox(
        height: 200,
        width: 175,
        child: YoutubePlayerIFrame(
          controller: YoutubePlayerController(
            initialVideoId: 'AmqDOA-JALg',
            params: YoutubePlayerParams(
              // Defining custom playlist
              showVideoAnnotations: true,
              startAt: Duration(seconds: 0),
              showControls: false,
              showFullscreenButton: true,
            ),
          ),
          aspectRatio: 16 / 9,
        ),
      ),
    ),
  );
};

```

Fig.5.14.Code snippet for video

If the user is directed to the professional support page then he/she has an option of choosing their consultant from the list of consultants based on the user preference.

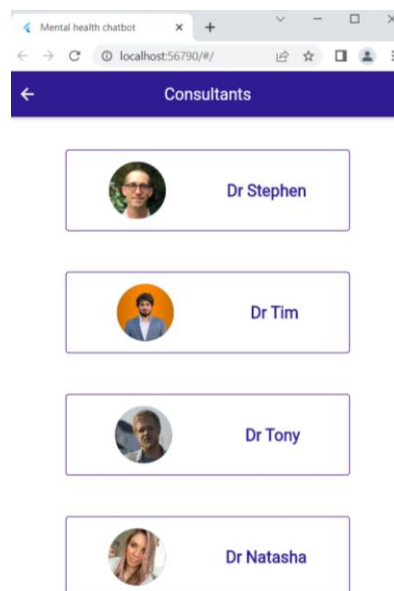


Fig.5.15.Consultant page

Once they finalize the professional consultant further they can schedule the appointment with that person based on their availability and timings.

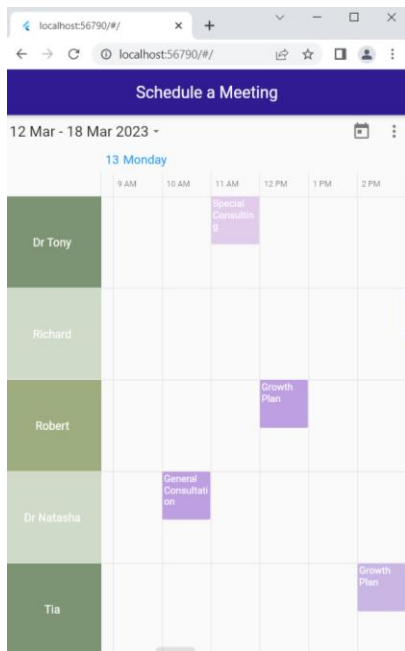


Fig.5.16.Scheduling appointment

```

final Random random = Random();
for (int i = 0; i < _employeeCollection.length; i++) {
    final List<String> employeeIds = <String>[
        _employeeCollection[i].id.toString()
    ];
    if (i == _employeeCollection.length - 1) {
        int index = random.nextInt(5);
        index = index == i ? index + 1 : index;
        employeeIds.add(_employeeCollection[index].id.toString());
    }

    for (int k = 0; k < 365; k++) {
        if (employeeIds.length > 1 && k % 2 == 0) {
            continue;
        }
        for (int j = 0; j < 2; j++) {
            final DateTime date = DateTime.now().add(Duration(days: k + j));
            int startHour = 9 + random.nextInt(6);
            startHour =
                startHour >= 13 && startHour <= 14 ? startHour + 1 : startHour;
            final DateTime shiftStartTime =
                DateTime(date.year, date.month, date.day, startHour, 0, 0);
            _shiftCollection.add(Appointment(
                startTime: shiftStartTime,
                endTime: shiftStartTime.add(const Duration(hours: 1)),
                subject: subjectCollection[random.nextInt(8)],
                color: colorCollection[random.nextInt(4)],
                resourceIds: employeeIds));
        }
    }
}

```

Fig.5.17.Code snippet for scheduling appointment

If an individual score exceeds -5 through sentiment analysis method then they will be asked to participate in the survey where it contains the series of QA. End-user's will reply to queries which suits them the most and based on their selection the bot produces the result which indicates whether he/she is stressed or depressed or little burnout.

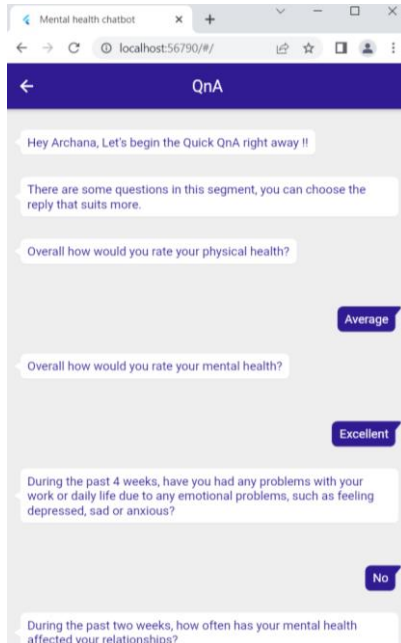


Fig.5.18.QnA screenshot

```

setState(() {
  UIList.add(message);
  score = score + int.parse(sentiment.analysis(text)["score"].toString());
  print(score);
  wait = true;
});
if (score <= -5) {
  ChatMessage negat1 = new ChatMessage(
    text: "Hey archana, you seem to be down, anything bothering you?",
    type: false,
  );
  ChatMessage negat2 = new ChatMessage(
    text:
      "I feel let's take a break here, why don't we do a small QnA session on how you feel?",
    type: false,
  );
  ChatMessage negat3 = new ChatMessage(
    text:
      "Incase you wanna talk to someone, let's get in touch with them Immediately!",
    type: false,
  );
}

```

Fig.5.19.Code snippet of Greeting message

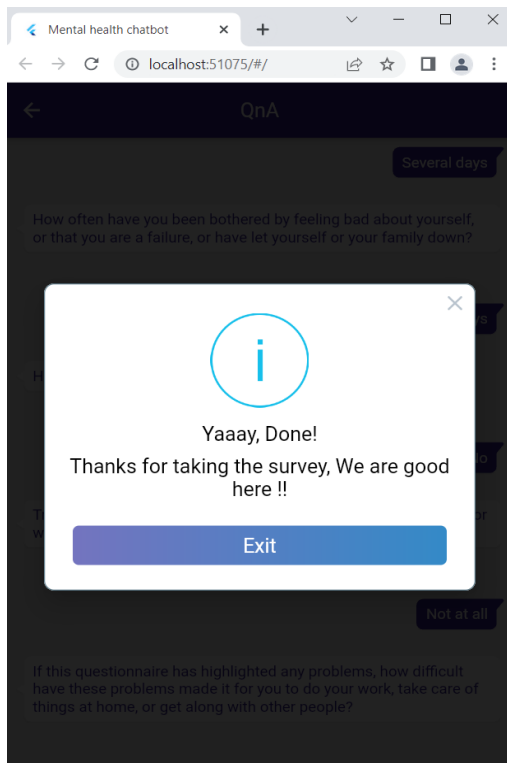


Fig. 5.20.Code snippet for Alert message

```
final_message() {
  // String s;
  print(score);
  if (score >= 25.5) {
    Alert(
      context: context,
      type: AlertType.info,
      title: "Yaaay, Done!",
      desc: "Thanks for taking the survey, We are good here !!",
      buttons: [
        DialogButton(
          child: Text(
            "Exit",
            style: TextStyle(color: Colors.white, fontSize: 20),
          ),
          onPressed: () => Navigator.pushReplacement(
            context, MaterialPageRoute(builder: (context) => MyHomePage())),
          gradient: LinearGradient(colors: [
            Color.fromRGBO(116, 116, 191, 1.0),
            Color.fromRGBO(52, 138, 199, 1.0)
          ]),
        ),
      ],
    ).show();
  }
}
```

Fig.5.21.Code snippet of Alert message when the survey result is positive

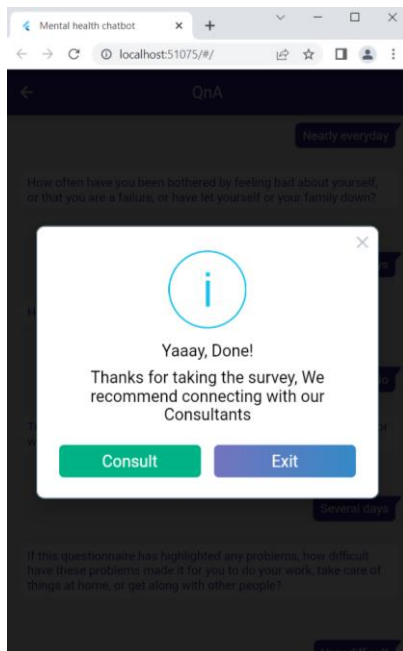


Fig.5.22. Code snippet of Alert message to consult professional

```
Alert(
  context: context,
  type: AlertType.info,
  title: "Yaaay, Done!",
  desc:
    "Thanks for taking the survey, We recommend connecting with our Consultants",
  buttons: [
    DialogButton(
      child: Text(
        "Consult",
        style: TextStyle(color: Colors.white, fontSize: 20),
      ),
      onPressed: () => Navigator.pushReplacement(context,
        MaterialPageRoute(builder: (context) => Consultants())),
      color: Color.fromRGBO(0, 179, 134, 1.0),
    ),
    DialogButton(
      child: Text(
        "Exit",
        style: TextStyle(color: Colors.white, fontSize: 20),
      ),
      onPressed: () => Navigator.pushReplacement(
        context, MaterialPageRoute(builder: (context) => MyHomePage())),
      gradient: LinearGradient(colors: [
        Color.fromRGBO(116, 116, 191, 1.0),
        Color.fromRGBO(52, 138, 199, 1.0)
      ]),
    ),
  ],
).show();
```

Fig.5.23.Code snippet of Alert message if the survey result is negative

The chatbot provides various benefits to people via these resources where they can find all the related information regarding the mental well-being in a single place. They can also schedule appointments based on their availability. Their time will be effectively utilized in a good way.

5.2.Summary

This chapter consists of the output screenshots of the chatbot along with its code snippet. This outlines how the entire system looks in the app starting from login page which is the first glance of the user. After the required credentials are entered it will be directed to the homepage where every essential features are present. An individual can either directly converse with the bot or take an assessment. On clicking the floating button, it can view the extended version of it which contains music page button, video page button and articles page button. Based on their desire, he/she can choose any of the specified options through which they can indulge in further activities.

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

AI/Chatbot is all about an always learning and improving system, hence there is a scope for plug and play of NLP depending on the situation. This system can also work as a SAAS model which will be served via cloud offerings with the help of firebase. More research can be done to improve the detection process and to create community level support with data privacy and complete automation. Inclusion of other health monitoring characteristics like bpm, stress level, sleep pattern etc., by integrating with IOT devices and inclusion of other relax therapy models like yoga, Zen mode etc., to provide a complete setup. Hence, the future works would be towards an all-in-one mental health well being system for everyone. It is possible to synchronize the sensory technology with this current chatbot to increase the accuracy of the identification and the accuracy of the response that chatbot should provide to the user using Internet of things(IOT). The wearables devices like fitness bands and smart watches can monitor heart rates and blood pressure etc., These devices can be tuned according to our necessity and increase the accuracy of the entire system. Discerning the individual's with personality disorder and pessimistic trait along with the people who have depression & anxiety are the anomalous factors. Still it is possible to the extent where we can identify those factors by monitoring their response keenly with the help of sensory technology. For example, we can compare the heart rate and blood pressure of the person while using the app. Moreover, the questionnaire analysis on top of sentiment analysis helps in double confirming the state of the individual who is taking the assessment. In this current study, the personal information or data shared across the chatbot isn't stored anywhere in the system. Everything happens at the run time therefore the sensitivity of the medical health concern will not be shared or stored anywhere. In future work, the specific mental health concerns can be added in terms of comparing the symptoms related to particular disorders. This research emphasizes the significance of mental health which needs to be addressed at the earliest and it can be accomplished through this study. The basic aim is to provide a simple, easily accessible and user-friendly chatbot to the people who are seeking for effective care for their mental health issue. This thesis paves way to a friendly environment for people to share their feelings and emotions to a virtual therapy chatbot without the fear of being judged and stigma. They get to know more about their mental health state and learn more in detail about the terminologies related to it and can indulge in activities which helps in building more positive and productive thoughts about life. This chatbot can be used by every people anywhere in the world at anytime.

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