A Machine Learning-based Mobile Chatbot with Cognitive Behavioral Therapy for Mental Health

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APPROVAL

This Project titled "**A Machine Learning-based Mobile Chatbot with Cognitive Behavioral Therapy for Mental Health**", submitted by *Sudipta Shahin* to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on *2-1-22*.

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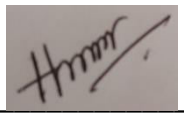

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We hereby declare that, this project has been done by us under the supervision of **Professor Dr. Md. Ismail Jabiullah, Professor, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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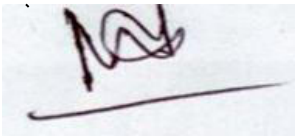

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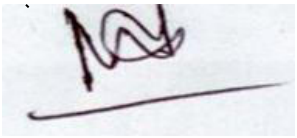

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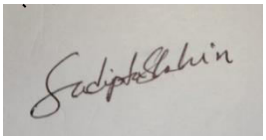

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ABSTRACT

A set of things or principles or methods or a group of devices or programs that are working together for serving a common purpose is a system. A subset of machine learning is deep learning. It is composed of deep neural networks where there are thousands and millions of artificial neurons. It mimics biological neurons and this method is based on artificial neurons which act as synapsys of the brain. Machine learning can be supervised where programmer finds out some method that helps to teach a program learn to learn something for a desired output, learning can also be unsupervised where a programmer create a program that can analyze the clusterized an unlabeled dataset and that can find pattern in the data with no human intervention which is natural self learning technique. Natural language processing is a one of the main sections of computer science and more specifically the section of artificial intelligence where mathematicians, linguistics people and programmer, researchers develop methods to teach computers to understand human text and spoken words in much the same way a human being can do.

This paper is all about how we can make a chatbot that can mimic a psychiatrist to serve general mental health issues like stress disorder, anxiety disorder with cognitive behavioural therapy which is like a question answer session. Here, we made a sample dataset with 800 plus conversations of a therapist and a patient. First, clean the data for the deep learning model. This model will take the data, analyze it and output a desired text. This model will input a text and output also a text. The predicted or the output text will be sent to the web api through the user mobiles conversation. This virtual

psychotherapist will provide cognitive behavioural therapy as virtually. And this whole system's job is to decrease users' stress, depression, anxiety and similar psychological problems. So we are designing a system which is a conjunction forms of deep machine learning algorithms, Natural language processing, Web REST api's and a mobile application developments. It's a simple mobile chatbot application where the chatbot will mimic a psychotherapist which will provide cognitive behavioural therapy to a user or a

patient. For making this system at first we need a basic knowledge of a programming language like C++, python. Then we need to learn supervised ML(Machine Learning) algorithms and dl(Deep Learning) algorithms like nn(Neural Networks), RNN(Recurrent Neural Networks) and basic understanding of NLP(Natural Language Processing) how this will work and how to convert a text into a vector. We also need to understand how a web server work and how an api works and how to insert or fetch data from the database. After that we need mobile application knowledge. In which mobile operating system our system will be perform good or we can gather a vast amount of users. This application is for those users who are suffering from mental health disorders like anxiety disorder, stress disorder behavioural disorder. In our country people think mental health is a taboo disease. So they don't want to overcome this problem. This chatbot system will help the user to overcome from the mental disabilities to lead a healthier and beautiful life. For using this application don't have to go outside for basic mental health issues. It will help users to reduce stress and anxiety. There are several limitations of our application though it is a conversational agent. One of the limitations of the chatbot is that it does not understand the context of human speech, if it is trained that way it can work well. If a user asks a question outside of his training, the boat will not be able to answer correctly. Probably it cannot answer complex queries, it only serves basic queries. Chatbots are built on the basis of this agent which cannot hold the user retention. Since the machine is taught to feel, it cannot feel like a human. For this reason, if someone is low, anxious or angry, then sometimes he does not understand. A human customer agent can easily understand the customer sentiment. However, in this present situation it is normally not

the work of machines. Therefore, chatbots cannot establish an emotional connection with the users. Understanding the current limitations of chatbots has forced programmers to be more aware when coding the chatbots. *keras*, *tensorFlow*, *scikit-learn, pytorch, nltk or gensim* are some of the advanced deep learning libraries and frameworks that are helping to develop better chatbots or any machine learning models. Chatbot needs more research into human behavior and to learn how to respond accordingly.

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CHAPTER 1

Introduction

1.1 Description

Mental health, defined by the World Health Organization (WHO) [1], is "Mental health is a condition where people know how to prioritize their own abilities, people can handle the day to day stress of life, work efficiently and they can fulfill their responsibility towards the society". It involves the ability of every person to maintain mental and social well-being which means how we think, feel and act for others and for ourselves. According to the WHO [1], absence of mental disorders is mental health. There are a lot of disorders in our human brain, such as anxiety disorders, stress disorders, dissociative disorders, behavior disorders, eating disorders, sleeping disorders and many more. The source of disorders is abnormality (essentials of understanding psychology) as the inability to function properly or effectively. This means, there are some people in this society who are born or are unable to adapt to the needs of the society due to birth or some isolated event. When an individual prevents him/her from functioning in their daily lives, causing them to experience distress, psychologists consider those individuals' behavior as abnormal behavior. From the history of mental health disorders were considered the work of the devil. But this is a mental health problem. According to a report, 17% of patients with psychiatric problems and 16.8% of men and 17% of patients with 92.3% of patients do not seek treatment. [2] The National Institute of Mental Health takes the technical direction from WHO(World Health Organization) revealed the survey results as titled "National Mental Health Survey, Bangladesh 2018-19" in a program at Krishibid Institute in Dhaka at April to June 2019. However the first study found that 16.1% of people had Psychiatric

Disorders and 15.3% of households had the condition. This survey shows that 6.7% has Depression Disorder, 4.5% of Anxiety Disorder, 2.1% are Somatic Symptoms and related disorders while 0.9% has Sleepwalk Disorder, 0.7% suffers Obsessive Compulsive Disorder , 0.3% has Neurodevelopment Disorder, 0.3% Neuro Cognitive Disorder, 0.2% has substance related and Addictive Disorder, 0.1% has Personality Disorder, 0.1% has Sexual Dysfunction, and 0.01% have Disruptive, Impulse Control and Conductive Disorders. Here we can see that, there are so many men and women at a young age or after that they are suffering from mental health issues. This issue affects their other daily lives like jobs, social communication, performance of work and physical capability. Today's scientist found some therapy and problem solving sessions for our disorders problem. In this paper we also find a solution for disorders like anxiety disorder(social anxiety disorder), stress disorder, behavioral disorders, personality disorder with a different approach. We want to make a mimic of a psychologist in a mobile app like google assistant or apple siri. By making mimicry of a psychologist in a mobile application we have to implement a deep learning ai model. Deep learning is a branch of machine learning that forms a pattern similar to the human brain that helps it make decisions or do a task. We want to apply cognitive behavioral therapy in anxiety disorder, stress disorder and behavior disorder. We create a model with natural language processing (NLP) which can understand the talk, then classify the user or the patient, which disorder he or she has and after that we apply our deep learning model for understanding the user perception and working on his problem with CBT. Actually here we are implementing CBT in a mobile application with a deep learning AI approach and creating an AI agent. Which can interact with the user.

1.2 History

In the 1950's, Alan Turing questioned his mind about whether machines could ever think he could formulate his thinking by making a test, which was called the Turing test where he questions people and machines about different things, with the aim of identifying humans. If the program or test can not differentiate the human and the machine then we can say that machines can think. First chatbot was created by Joseph Weizenbaum in 1966 at MIT. Which was very familiar to humans imitation. It is called ELIZA. When a sentence is given as input, ELIZA recognizes the keywords and patterns associated with that keywords and it also consists of pre-programming and a set of rules that help it to respond appropriately. [3] ELIZA has been playing an instrumental in the advancement of increasingly intelligent chatbots. Kenneth Colby was created a chatbot which can impersonate a paranoid schizophrenic and they call it PERRY which was founded at Stanford University in 1972.

Richard Wallace built a sophisticated chatbot in the 1950's that could have stored his input output patterns in a document. Those are written in AIML(Artificial Intelligence Markup Language), which is an extension of XML. It is still used by many today. ALICE has won the Loebner Prize three times.

1.3 Chronological development

In 1950 a test was developed by Alan Turing which is called the Turing test. It was the first concept of how a machine can think like a human. In 1966 at MIT AI laboratory Eliza was introduced by Joseph Weizenbaum who created and demonstrated excess of communication between man and machine, Eliza

mimicked the conversation using pattern matching and substitution methods that let the user know that he understands it creates an illusion but there is no structure in it to make the events relevant.

Parry was created by Kenneth Colby in 1972 , a psychiatrist at Stanford's. [4] When ELIZA was a simulation of a therapist who is Razorian while PARRY tried to simulate a person with paranoid schizophrenia. [5]That program was created based on an individual's beliefs and conceptualization and the person with paranoid schizophrenia (judgments about conceptualizations: accept, reject, neutral). It also developed some techniques which were more advanced than ELIZA. After that everyone knows it as "ELIZA with attitude"**.** [6] In 1970's PERRY was tested by many forms of the Turing test. A team of experienced psychiatrists analyzed the combination of real patients and computers using a teleprinter and another team of 33 other psychiatrists was shown a transcript of the conversation. After that they are asked which patient is a real patient and which patient is a virtual or computer patient. [7] Only 46 percent of psychiatrists were able to make accurate estimates. [8]Rollo Carpenter created a Chabot called *Jebberwacky* who was a British programmer. Its main goal is to make a simulation of expressing human words in a more interesting and lively way.

In 1985, a robots company built a talking robot whose name is Tomay. It was a tiny personal robot. It is truly astounding what they were able to accomplish utilizing the resources at the time to manufacture and sell this product line. The Omnibot [9] had a cassette tape player built into the chest area of the robot, which slid out like a drawer to reveal the cassette and could record and playback sequences of commands, as well as regular audio recordings.

In early 1990's, Dr. Sabitz had to deliver many sound cards made by Creative Technology. [10]. The program is running conversations with the user as if it were a psychologist although most of the reactions were like "WHY DO YOU FEEL THAT WAY?" rather it was a mixed reaction. When it does not understand a bunch or word or a phrase, it answers something like "THAT'S NOT MY PROBLEM".
Alice was born in 1995 to Richard Balles. It was written in java in the year of 1998. and also uses an XML schema called AIML and there were some certain set of rules for the reply in a desired way. [12]

Json Hutchens developed the HEX chatbot[13] in 1996. It has similar functionality as ELIZA and is also capable of natural language processing. It was active from 1964 to 1966. It worked using a technology called pattern matching and it can also generate natural speech. In 1996 Loebner prize was won by Hutchens.
In late of june 2001 SmarterChild [14] was founded by ActiveBuddy, Inc. It was a very intelligent bot and it got a huge response in Instant Messaging Network. An idea came to Watson head in 2006 which was being designed to compete on the TV show called Jeopardy. After the first test it was realized that it could give only 15% correct answers but gradually it started losing to the human competitors.

In 2010, Siri was first introduced. Siri was born in SRI International Artificial Intelligence Center, and is a branch of the US Defense Advanced Research Projects Agency's (DARPA).[15]Its co founders are Dag Kittlaus, Tom Gruber, and UCLA alumnus Adam Cheyer.[15]
A colleague from Norway named KIttlaus named the chatbot SIRI which means “beautiful woman who leads you to victory”.
Nuance Communications built SIRI’s speech recognition system.[15] Nuance CEO Paul Ricci confirmed that they built SIRI’s speech recognition system at a

2011 technology conference[16][17]. [18] This speech recognition system is a multitude of machine learning techniques, including the CNN(Convolutional Neural Networks) and LSTM(long short-term memory). [19]
The first prototype of Siri was used using an active platform and was later implemented by SRI International and Ecole Polytechnic Federal de Vrie Group. The Active platform focuses on a Ph.D. thesis led by Didier Guzzoni, who later joined Siri as its chief scientist.[20] SIRI was bought by Apple inc. in 2010.[21] In 1986, a preliminary video of Apple's digital personal assistant was released.

Google launched the GOOGLE NOW chatbot in 2012. It was founded by Gene Roddenberry, after his wife Majel Barrett and codenamed as ‘Majel’. It was also named as ‘assistant’.

Amazon Alexa[22] is a virtual assistant technology which is based on Ivona and which is a Polish Speech Synthesiser and it was founded in 2014**.** It is capable of doing some work in the daily work of our phone like
voice command interaction, music playbacking, making list, set the alarms, news, traffic news, sports, stock market information and many other real time jobs.[23] It was first used in Echo Dot, Amazon speaker, Echo Studio which was made from Amazon Lab126.

Microsoft created a virtual assistant called Cortana in 2015. Cortana can set alarms, reminders, identify voices and answer questions using information from the Bing search engine. Halo was a fictional artificial intelligence character in the video game series named after it.

In 2016 facebook announced a bot platform for messenger, including apis to build chatbots to interact with the users.

Dr. Alson Darcey founded a chatbot in 2017 which is called Woebot. This is the first time that a chatbot has been able to apply psychiatric therapy. It is designed for psychiatric therapy and efficiency, for beautiful writing, and for natural language processing. [24]

CHAPTER 2

Review works

No	Title	Abstract
1.	A Review of AI Based Medical Assistant Chatbot [25]	The advent of artificial intelligence as well as machine learning and deep learning in the present age of computers, machines have started mimicking humans. An excellent example of natural language processing is the chatbot, which is classified as a conversational agent. A program that allows people to talk with machines. This platform is based on artificial intelligence and focused on mobile, web technologies. A chatbot represents a machine that answers any question by processing normal human language. And it also processes its answers in natural language so that people can understand and these processes are done through natural language processing. Chatboats can play a great role in the world of nursing as well as take steps in an easy way to manage professionals. Health chatbots can communicate with the patient together one to one and review their questions at the same time.

2.	A Virtual Agent to Support Individuals Living With Physical and Mental Comorbidities: Co-Design and Acceptability Testing [26]	In addition long or short term physical problems, people also face many psychiatric health problems. As healthcare services struggle to reach all levels, the promotion of digital tools is essential for the patient to manage his or her own health. Chatbot is such a technology which is an automated virtual agent based on artificial intelligence. The main goal of this study is to create an automated virtual agent to implement self-care for patients with chronic pulmonary obstructive disease. Although the content they created for the virtual agent had a clear psychological approach, patients did not clearly distinguish between physical and mental health needs. This autonomous virtual agent that was accepted by supported self-management by the volunteers. A co-design process that allows a research team to identify the principles, content, and effectiveness of law design in order to provide self-management support to adolescent adults.
3.	Artificial intelligence and mobile apps for mental healthcare: a social informatics perspective [27]	Artificial intelligence has long been used in mental health. This paper aims to examine AI chatbots, specifically it will be served through mobile applications for mental healthcare (MHapps), with pay attention to the social impact of this technology. For example, This MHApps chatbots are primarily programmed with the help of mental health strategies to help people with anxiety and depression but this technology does not guarantee the personal safety of the people. The idea came from a social information science perspective, which was implemented in April 2019. A method used to combine information science and social work for literary analysis was a borrowed method. It is designed to keep pace with the growing demand for mental health services in the field of technology and development. This chatbot is not actually the removal of therapists and other physicians.This study is small in the role of AI in supporting mental health in information science research which adds a growing part.

4.	Artificial Intelligence-Assisted Online Social Therapy for Youth Mental Health [28]	Psychiatric health care may not be available in the early hours of the morning, but it may be a long-term end-to-end program. However, It is often difficult to get first aid early intervention treatments, this may not be feasible. It is designed especially for young people who may find that an adjunctive Internet-based intervention can provide an affordable and attractive alternative to prevent the disadvantages of the intervention. This paper provides an interactive social media-based platform for mental health recovery, primarily with the development of web applications. This application basically discusses the inclusion of advanced computational and artificial intelligence methods to increase user engagement and improve the discovery and distribution of therapy materials. Here we outlined the basic features of the web application and the outline of the interface. Includes concepts related to system innovation, as well as system limitations. Its function is to direct current inspiration and focus on using user realistic computational and artificial intelligence methods and to further improve the system with innovative mechanisms for providing therapy content to users. In particular, we cover our usage of natural language analysis and chatbot technologies as strategies to tailor interventions and scale up the system. To date, the innovative MOST system has demonstrated viability in a series of clinical research trials. Given the data-driven opportunities afforded by the software system, observed usage patterns, and the aim to deploy it on a greater scale, an important next step in its evolution is the incorporation of advanced and automated content delivery mechanisms.

5.	CAREBOT: A COGNITIVE BEHAVIOURAL THERAPY AGENT USING DEEP LEARNING FOR COVID-19 [29]	Due to the Corona epidemic, a large population of the world is suffering from mental health problems. CareBot, an automated psychoanalysis Chatbot can help at multiple levels for dealing with this stress, anxiety and overthinking during Covid-19 tough times. This Chatbot is an application that will provide online therapy for supporting people experiencing emotional and mental distress by letting them chat to an AI based mental health Chatbot.. This study focuses on the detailed framework of Carebot describing multiple engines and finally the recommendations counselled by the CareBot.
6.	Deep learning for language understanding of mental health concepts derived from Cognitive Behavioural Therapy [30]	We have seen through natural language processing that deep learning and distribution of words and sentences affect the processing of the presented language and this will impact on a number of natural language processing tasks, such as similarity, entailment and sentiment analysis. Here we introduce a new task, understanding of mental health concepts derived from Cognitive Behavioural Therapy (CBT). Our results show that the performance of deep learning models combined with word embeddings for sentence embeddings significantly outperform non-deep-learning models in this difficult task. This understanding module will be an essential component of a statistical dialogue system delivering therapy.

CHAPTER 3

Proposed work

3.1 Description

At first we user login in our system the login will be authenticated and the user will be authorized. When the user enters the application will open a chat interface which will be familiar with our facebook messenger, or google hangouts or other chat messengers. We will apply ux design in our system. When the user writes something as an input then, this text input will directly go to our server with REST api. Then the server will save the data in the database and also pass the data to the data preprocessing unit. When data comes to the data preprocessing unit it will process the data to remove punctuations, symbols, numbers, extra spaces and make it a lowercase raw text or string. After that this data will pass to our model. Then our model processes it and finds the best output for the user.

3.2 Pseudo presentation

```
Program baby_x(num_words, embedding_matrix, lstm_cell,
trainable=False, bi_direc=True):
      model ← Sequential model object from keras
      If not trainable then
            model_add ← EmbeddingLayer object
            model_add ← MaskingLayer object
      else
            model_add ← EmbeddingLayer object
      end if
      # multiple lstm cell
      if lstm_layer > 1 then
            for i to [lstm_layers - 1]
                  model_add ← LSTMLayer obj with required params
            end for
```

```
# add final lstm layer
if bi_direc then
      model_add ← BidirectionalObj from keras with required params
else
      model_add ← LSTM obj
end if

model_add ← DenseLayer obj from keras
model_add ← DropoutLayer obj from keras

return model
```

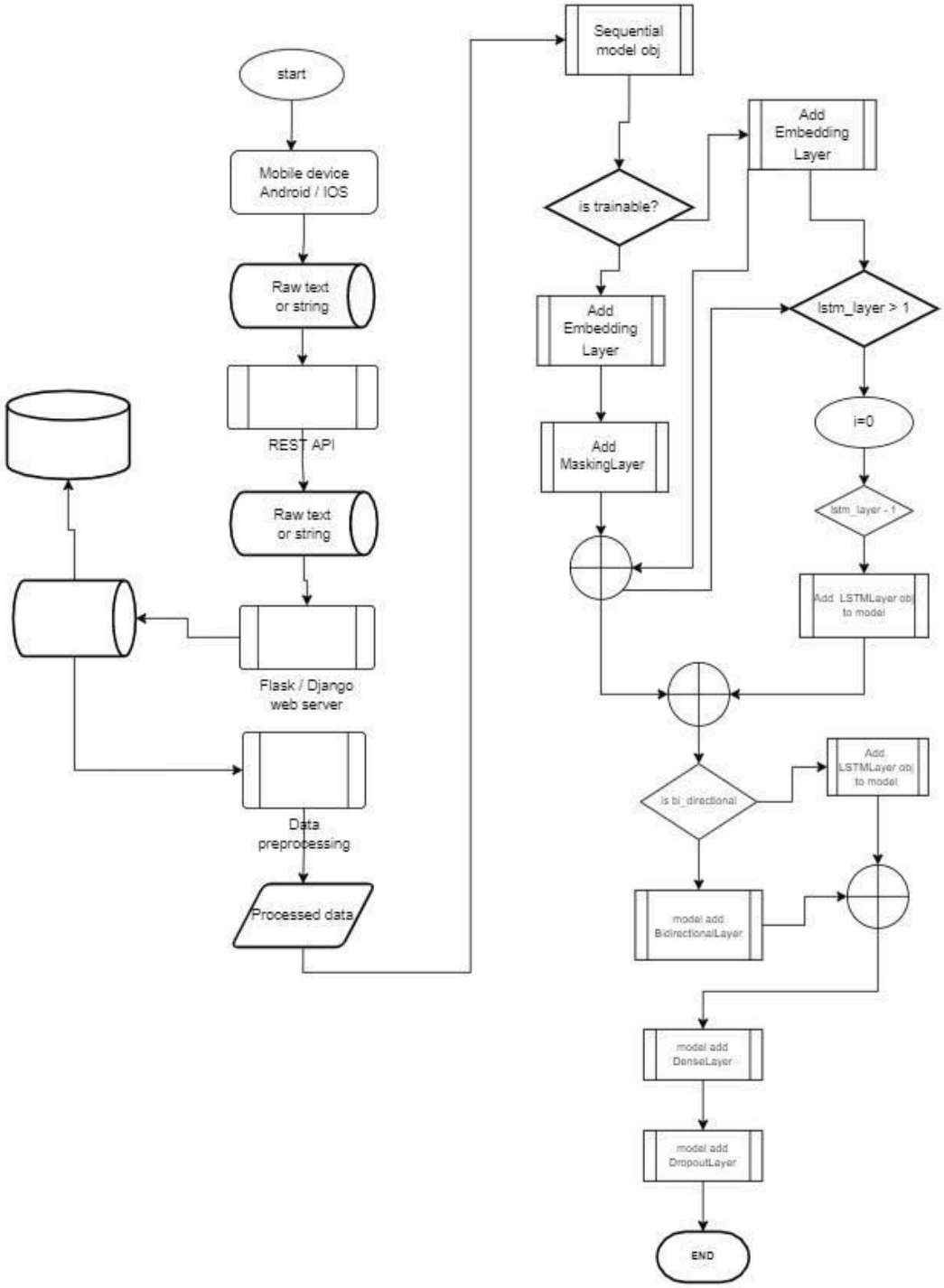
3.3 Algorithm

This model will be made of nlp, deep learning algorithms. Here we are using sequence to sequence encoder decoder algorithms. It is in the family of machine learning approaches used for natural language processing. This model turns a sequence into another sequence. This model is separated into 2 sub models. Seq2seq steps are following below:

1. Define those input parameters for the encoder model.
2. Build the encoder model for seq2seq model.
3. Define the input parameters to the decoder model.
4. Build the decoder model for training
5. Build the decoder model for the interface
6. Build the decoder model layer by putting step 4 and step 5 together
7. Combine the encoder and decoder models for the seq2seq

Our chatbot will work as a mental health professional, so we need to initially fit some data to its memory like humans. On that memory initially it will counseling our users. Day to day this model will study our user and improve its knowledge to serve better counseling.

3.4 Flow chart



3.5 How it works

We need to make the Sequence to Sequence model or the Encoder / Decoder model. So at first we need to get the dataset with python `file.readlines()` with `utf-8` encoding which is used for electronic communication defined by unicode standard, derived from unicode transformation format - 8 bit. Then read the file with `pandas.read_csv()` and split the data and store it in python variables. After that I need to preprocess the data or clean the data.
When we get the text data then we need to import `nltk.tokenize.sent_tokenize` and import `tensorflow.keras.preprocessing.text.Tokenizer` clean the dataset. Then convert the dataset in sentences with `sent_tokenize`. After we are going remove the punctuations, symbols, numbers, special characters and extra spaces. After that, we are using two methods from `Tokenizer.fit_on_text()` and `Tokenizer.texts_to_sequences()` to each texts transform to a sequence of integers. We are going to make a method to create a sequence of vectors and create features and labels. Then we have to import another library which is `sklearn.utils.shuffle` for shuffling the data and split it into four types which are feature of training data, features of validation data, labels of training data and labels of valid data as the train and testing data. After that we have to make the `embedding_matrix` from word_index which is word from its index from the dataset. After that we are going to create the sequence to sequence model by importing `tensorflow.keras.models.Sequential` for the model, `tensorflow.keras.layers.LSTM`, `tensorflow.keras.layers.Dense`, `tensorflow.keras.layers.Dropout`, `tensorflow.keras.layers.Embedding`,

`tensorflow.keras.layers.Bidirectional` for the layers, `tensorflow.keras.optimizers.Adam` for optimization. We have to create a Sequential object and add the layers to it. The add the Embedding layer which is input dimension will be the number of words in the dataset and output dimension size will be the column length of embedding matrix and instantiate the layers weights to with the embedding matrix and mask_zero property will be True because of we are going to use the Boolean, whether or not the input value 0 is a special padding value is masked out. This is very useful when using recurrent layers which may take variable length input. If this is True, then all subsequent layers in the model need to support masking or an exception will be raised. If `mask_zero` is set to True, as a consequence, index 0 cannot be used in the vocabulary `(input_dim should equal size of vocabulary + 1)`. Then we add the LSTM layers with the predefined size of `lstm_cells` and the `dropout` property will be 0.1 and recurrent_dropout will be also 0.1. After that we have to add the `Dense` layer and the activation function will be rectified linear unit as `relu (tensorflow.keras.activations.relu)` After add the `Dropout(128)` layer which `dropout` will be 0.5 the add the Dense layer which size will the numbers of words in the dataset. Then we are saving the model `tensorflow.keras.models.save_model` with the instance of the model and the `file_path` where the model will be saved as `h5` extension. Then we have to train the model and predict the sequence of output.

CHAPTER 4

Implementations

4.1 Examples of application

There are similar most popular types of apps now on the market which are Wysa, Woebot and Youper.

4.1.1 Wysa

Touchkin developed Wysa and it is an AI-based emotionally intelligent mobile chatbot app. The goal of this bot is building and it promotes mental resilience and mental well-being using a text-based conversation interface. It helps the user develop positive self-expression and also responds to the emotions expressed in the user's written conversations and uses evidence-based self-help practices in their conversations that are done using ai and which are CBT, dialectical behavior therapy, inspirational interviews, positive Behavioral Support, Behavioral Strengthening, Mindfulness, and Guided Microactivity and Tools to Encourage Users to Build Mental Resilience Skills. Engaging with the app is free and available 24×7, a human coach is also available for the paid service. It used an early in the market app version that included only the free always-available chatbot service. This application encourages its users to manage strength, focus, anxiety, relaxation, sleep, anxiety, conflict and other situations.[30] This will solve the problem by interacting with the users. It varies from person to person, depending on their message and context for each user. At various points as

the user speaks, a user is presented with open and closed app design questions that test the usefulness of these sessions and require user feedback. This social service process was not specified by users. It works by measuring changes in human behavior and emotions over time. The purpose of measuring change in the application was to understand user experience and engagement. It was securely stored on a private cloud server and all transmissions from and to the app were encrypted using recognized security standards. Screening responses were tested to compromise and de-identified for app identifiers and all user-generated conversations. [32]

4.1.2 Woebot

Woebot is an automated chatbot designed to provide CBT in the form of daily conversation and mood tracking. It can be used on desktop or mobile or tablet through messenger. It combines emoji images with the user's mood as well as words to blend in well with the user and also various video games are presented based on the mood. It included an "onboarding" process that introduced the bot on the first day, completely unable to fully understand the user, adding that the bot could feel like a person, choosing a "self-adventure self-help book". The user will be informed about the therapy through their conversations. This application is primarily for early use.[33]The boat uses different calculation methods based on different characteristics.

4.1.3 Youper

Youper is a conversational chatbot designed to help the user identify, track and process the thoughts and feelings of the user. It uses Cognitive Behavioral Therapy and Assistance and Commitment Therapy which can help improve the user's mood and sleep patterns and reduce their anxiety, stress and depression symptoms. Youper's focuses on the user's thoughts and identifies how they are feeling from the descriptive word menu. Then a scale lets them rate the strength of that emotion from "slightly" to "extremely." It considers him and asks more questions so that the real feeling of the user is revealed. Users are also given options for mindfulness exercises and journaling prompts. [34]

4.2 Requirement analysis

4.2.1 Required software

1. Python 3.7 - 3.9
2. Jupyter notebook
3. Vscode or Android studio
4. MySql database

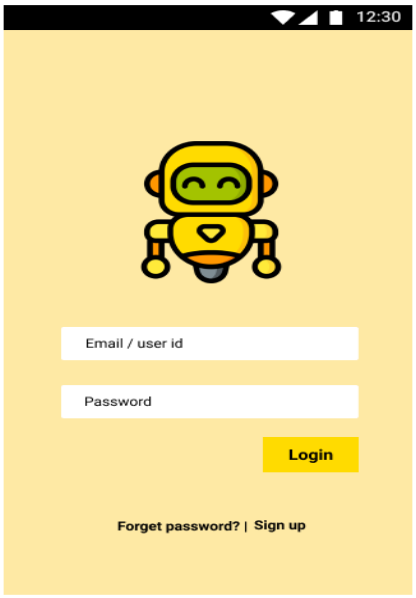
4.2.2 Required hardware

1. Processor: Intel core i5 / AMD Ryzen 5000
2. RAM: 8GB

4.3 Dataset samples

	Therapist	Patient
1	Therapist	Patient
2	Mike, I was reading an important book on making therapy more effective and I thought of you.	Oh?
3	Yes, and I have some ideas about how we can help you get better faster. [being collaborative] Is it okay if I tell you about it?	Okay.
4	One thing I read was called "setting the agenda." That means at the b	How does that sound?
5	Okay, Sally, you said you wanted to talk about a problem with finding a part-time job?	Yeah. I need the money . . . but I don't know.
6	What's going through your mind right now?	I won't be able to handle a job.
7	And how does that thought make you feel?	Sad. Really low.
8	What's the evidence that you won't be able to work?	Well, I'm having trouble just getting through my classes.
9	Okay. What else?	I don't know. I'm still so tired. It's hard to make myself even go and look for a job, much less go to work every day.
10	In a minute we'll look at that. Maybe it's actually harder for you at this	. . . No, not that I can think of.
11	Any evidence on the other side? That you might be able to handle a j	I did work last year. And that was on top of school and other activities. But this year . . . I just don't know.
12	Any other evidence that you could handle a job?	I don't know. . . . It's possible I could do something that doesn't take much time. And that isn't too hard.
13	What might that be?	A sales job, maybe. I did that last year.
14	Any ideas of where you could work?	Actually, maybe the [university] bookstore. I saw a notice that they're looking for new clerks.
15	Okay. And what would be the worst that could happen if you did get a	I guess if I couldn't do it.
16	And if that happened, how would you cope?	I guess I'd just quit.
17	And what would be the best that could happen?	Uh . . . that I'd be able to do it easily.
18	And what's the most realistic outcome?	It probably won't be easy, especially at first. But I might be able to do it.
19	Sally, what's the effect of believing your thought, "I won't be able to ha	Makes me feel sad. . . . Makes me not even try.
20	And what's the effect of changing your thinking, of realizing that possi	I'd feel better. I'd be more likely to apply for the job.
21	So what do you want to do about this?	Go to the bookstore. I could go this afternoon.
22	How likely are you to go?	Oh, I guess I will. I will go.
23	And how do you feel now?	A little better. A little more nervous, maybe. But a little more hopeful, I guess.
24	Sally, as I explained on the phone, this is our evaluation session. It's	Yes.

4.4 Target output screen



CHAPTER 5

Computational Complexities

5.1 Functional description

1. Sequential : It's a group of layers of stack into a tensorflow keras mode (tf.keras.Model). It has two property layers which Used for naming and listing the inner layer of the model and naming the mode. It has methods which are
    a. add : It will adds a layer object on top of the layer stack
    b. compile: It will configure the model for training. It has some property which are
        i. optimizer: instance of optimizer like SGD(Stochastic Gradient Descent), Adam
        ii. loss: It's a loss function. loss = function(y_true_data, y_pred_data)
        iii. metrics: List metrics that are generated by the model during training and testing the model. Each of these can be a string name of the function, function or a tf.keras.metrics metric instance
    c. evaluate: It will return the loss value and metrics values for the model in the test model.
    d. fit: Trains the model for a fixed number of epochs
2. Embedding: Turns positive integers into dense vectors of fixed size
    a. input_dim : Integer Size of the vocabulary
    b. output_dim: Integer. Dimension of the dense embedding.

c. embeddings_initializer: Regularizer function applied to the embeddings matrix
d. embeddings_regularizer: Regularizer function applied to the embeddings matrix
e. mask_zeor: Boolean, whether or not the input value 0 is a special "padding" value that should be masked out. This is useful when using recurrent layers which may take variable length input. If this is True, then all subsequent layers in the model need to support masking or an exception will be raised. If mask_zero is set to True, as a consequence, index 0 cannot be used in the vocabulary.
f. input_length: the input length size will be the size of the sequence.

3. LSTM: It's a long short time memory layer.
    a. units: Positive integer, dimensionality of the output space.
    b. activation: Activation function to use. Default: hyperbolic tangent (tanh). If you pass None, no activation is applied (ie. "linear" activation: a(x) = x).
    c. recurrent_activation: Activation function to use for the recurrent step. Default: sigmoid (sigmoid). If you pass None, no activation is applied (ie. "linear" activation: a(x) = x).
    d. bias_initializer: Initializer for the bias vector. Default: zeros.
4. Bidirectional
    a. layer: tf.keras.layers.RNN instance such as tf.keras.layers.LSTM or tf.keras.layers.GRU
5. Dense: It's a fully connected layer. It has the same property as LSTM

6. save_model: It is used to save the model. Thus models can be instantiated in the exact same state, without any of the code used for model definition or training.

CHAPTER 6

Conclusions

6.1 Description

For developing the system we have to make a mobile application program, write the backend program with Flask framework with python in this part we have to also make the api for made bridge connection with the server and the model and our Deep machine learning model with recurrent neural network and Long-short time memory LSTM which is a special form of rnn. At this moment we are only making the model. Which is a sequence to sequence or encoder decoder algorithm where we pass a sequence of input and get the expected output as a sequence. We are not done yet mostly with our system. Mobile application, backend server and the API's are not done yet. Mobile applications will be written in Java for Android devices, where our user will use the app. We have to have an interactive user interface. User login and authentication system, user database and make the write the program for reading the data from server with REST api. After that we have to make the Backend server which is a junction where the mobile and the model talk to each other or make the connection. In this part we are also writing the API.

6.2 Actual outcome

	Scenario	Test type	Expected result	Actual outcome
User registration	Verify that email input field get the only valid email and nothing else	Enters a valid email	Application should be able to excepted only valid and unique emails	Application expect valid emails
	Verify the user name input field where name should be under 20 characters only	Enter a the user name under 20 characters	Application should be able to expected only the unique name which is under 20 characters	Application expect unique name under 20 characters
	Verify the user password field where the password should be strong which has at least one number and one uppercase letter and length will 6 characters long	Enter the password to the password field with one uppercase letter and one number	Application should be able to expected only those password where the password string have one uppercase and one number	Application expect the password with the length of 6 characters and one uppercase and one number

User login	Verify the user email or user name input field from the database	Enters the email or the user name	Application should be able to check the email or the user name form the database	Application only authenticate the user which is only match from database
Database	Verify the user data and the chatbot and store it in the database	Enter inputs from the chat text field	Application should be able to check the text	Application expect the text data from the user and output of the chatbot text
REST API	Verify the user input text during the chat if it is valid then send it to the server	Enter inputs from the chat text field	Application should be able to check the text and verify as the user input	Application should be able expect the text make as json format and send to the server

Reference:

[1] WHO, https://www.who.int/, 28-8-21, 1.00AM

[2]who.int, https://www.who.int/docs/default-source/searo/bangladesh/pdf-reports/cat-2/nimh-fact-sheet-5-11-19.pdf?sfvrsn=3e62d4b0_2

[3] Jack Cahn, “CHATBOT: Architecture, Design, & Development” pp. 3-4
[4] Güven Güzeldere; Stefano Franchi , "dialogues with colorful personalities of early ai". Stanford Humanities Review, SEHR, volume 4, issue 2: Constructions of the Mind. Stanford University, Retrieved 2008-02-17.
[5] Güven Güzeldere; Stefano Franchi (1995-07-24). "dialogues with colorful personalities of early ai". Stanford Humanities Review, SEHR, volume 4, issue 2: Constructions of the Mind. Stanford University. Retrieved 2008-02-17
[6] Boden 2006, p. 370
[7] Colby, 1972, p. 220.
[8] Saygin, Cicekli, Akman (2000), "Turing Test: 50 years later" (PDF), Minds and Machines: 463–518
[9] theoldrobots, http://www.theoldrobots.com/omnibot.html, 20-2-21, 10.00AM
[10] wikipedia, https://en.wikipedia.org/wiki/Creative_Technology, 28-12-21, 12.00PM
[11] yakbots, https://yakbots.com/chatbot-history-the-hex-chatbot-and-megahal/, 1-1-22, 9.00PM
[12] Thompson, Clive (July 7, 2002). "Approximating Life". Magazine. The New York Times. Retrieved August 30, 2013.
[13] yakbots, https://yakbots.com/chatbot-history-the-hex-chatbot-and-megahal/, 1-1-22, 9.00PM
[14]internetnews, https://www.internetnews.com/enterprise/activebuddy-retires-smarterchild-on-aim/, 1-1-22, 9.00PM
[15] Bosker, Biance (January 24, 2013). "SIRI RISING: The Inside Story Of Siri's Origins – And Why She Could Overshadow The iPhone". Huffington Post. Retrieved June 10, 2017.
[16] Siegler, MG (October 5, 2011). "Siri, Do You Use Nuance Technology? Siri: I'm Sorry, I Can't Answer That". TechCrunch. AOL. Retrieved June 10, 2017
[17] Kay, Roger (March 24, 2014). "Behind Apple's Siri Lies Nuance's Speech Recognition". Forbes. Retrieved June 10, 2017.
[18] Siegler, MG (October 5, 2011). "Siri, Do You Use Nuance Technology? Siri: I'm Sorry, I Can't Answer That". TechCrunch. AOL. Retrieved June 10, 2017
[19] Levy, Steven (August 24, 2016). "An exclusive inside look at how artificial intelligence and machine learning work at Apple". Wired. Retrieved June 10, 2017
[20] Guzzoni, Didier (2008). Active: a unified platform for building intelligent applications (Thesis). doi:10.5075/epfl-thesis-3990. Archived from the original on June 4, 2018. Retrieved June 4, 2018
[21] Olson, Parmy. "Steve Jobs Leaves A Legacy In A.I. With Siri". Forbes. Retrieved October 5, 2019
[22] cnn, https://edition.cnn.com/2018/10/16/tech/alexa-child-development/index.html, 2-1-22, 12.03AM
[23] sztucznainteligencja, https://www.sztucznainteligencja.org.pl/en/ivona-alexa-vika-or-intelligent-girls-from-gdansk/][Amazon Gets into Voice Recognition, Buys Ivona Software to Compete Against Apple's Siri"., 12-12-21, 3.00PM
[24] chatbotsmagazine, https://chatbotsmagazine.com/woebot-worlds-first-mental-health-chatbot-gets-8-million-in-funding-3369a1e7ba9f#:~:text=The%20world%27s%20first%20mental%20health,with%20%E2%80%9Coccasional%20dorky%20joke%E2%80%9D, 2-1-22, 12.06AM
[25] Chetan Bulla, A Review of AI Based Medical Assistant Chatbot, pp. 1
[26] Katherine Easton1,2, BSc, MRES, PhD; Stephen Potter1,2, BSc, MSc, PhD; Remi Bec3,4, MA, PhD; Matthew Bennion2,5,6, BEng, MSc, PhD; Heidi Christensen2,5, MSc, PhD; Cheryl Grindell3, BSc, MSc; Bahman Mirheidari5, BSc, MSc, PhD; Scott Weich1, MSc, MD; Luc de Witte1,2, MD, PhD; Daniel Wolstenholme3, BSc, MMSc; Mark S Hawley1,2, BSc, PhD, A Virtual Agent to Support Individuals Living With Physical and Mental Comorbidities: Co-Design and Acceptability Testing, pp. 1-2
[27] Alyson Gamble, Artificial intelligence and mobile apps for mental healthcare: a social informatics perspective,

[28] Simon D'Alfonso1, 2*, Olga Santesteban-Echarri 1, 3, 4, Simon Rice1, 3, Greg Wadley 2, Reeva Lederman2, Christopher Miles 1, John Gleeson5 and Mario Alvarez-Jimenez 1, 3, Artificial Intelligence-Assisted Online Social Therapy for Youth Mental Health, pp.2
[29] Jack Cahn, "CHATBOT: Architecture, Design, & Development" pp. 3-4
[30] Lina Rojas-Barahona1, Bo-Hsiang Tseng1, Yinpei Dai1, Clare Mansfield2 Osman Ramadan1, Stefan Ultes1, Michael Crawford 3 and Milica Gaˇsi´c1, Deep learning for language understanding of mental health concepts derived from Cognitive Behavioural Therapy
[31] sztucznainteligencja, https://www.sztucznainteligencja.org.pl/en/ivona-alexa-vika-or-intelligent-girls-from-gdansk/Amazon Gets into Voice Recognition, Buys Ivona Software to Compete Against Apple's Siri"., 12-12-21, 3.00PM
[32] Becky Inkster1 , DPhil; Shubhankar Sarda2 , BSc (Physics); Vinod Subramanian3 , MBA, An Empathy-Driven, Conversational Artificial Intelligence Agent (Wysa) for Digital Mental Well-Being: Real-World Data Evaluation Mixed-Methods Study, p=4
[33] Becky Inkster1 , DPhil; Shubhankar Sarda2 , BSc (Physics); Vinod Subramanian3 , MBA, An Empathy-Driven, Conversational Artificial Intelligence Agent (Wysa) for Digital Mental
[34] Kathleen Kara Fitzpatrick1* , PhD; Alison Darcy 2* , PhD; Molly Vierhile1 , BA, Delivering Cognitive Behavior Therapy to Young Adults With Symptoms of Depression and Anxiety Using a Fully Automated Conversational Agent (Woebot): A Randomized Controlled Trial, p=3

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www.science.gov
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Sumit Raj. "Chapter 1 The Beloved Chatbots", Springer Science and Business Media LLC, 2019
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Fernando A. Mikic, Juan C. Burguillo, Daniel A. Rodriguez, Eduardo Rodriguez, Martin Llamas. "T-Bot and Q-Bot: A couple of AIML-based bots for tutoring courses and evaluating students", 2008 38th Annual Frontiers in Education Conference, 2008
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Science and Business Media LLC, 2021

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