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User Adaptive Chatbot for Mitigating Depression

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Abstract

The rate of depression is growing at an alarming rate. A study found that people are more likely to open up to a talking computer than a human. The aim of this paper is to motivate a person going through low phase of his life and to avoid ill-effects of depression. We propose a chatbot that can enable positivity boosting conversation with the user. The chatbot will personalize its replies as per user to keep the conversation engaging. It is made emotionally supportive by training it over a motivating dialogue corpus. The corpus is extended with the users historical chat data from social media platforms. Tensorflow framework and high power GPU is required by server for training. The advantage of such a system is that instead of reaching a phase requiring a visit to a psychiatrist, an online free service will reach many people, will mediate ill-effects of depression and contribute to the betterment of society.

Key Words : Affective computing, Artificial intelligence, Chatbot, Cognitive computing, Depression

1 Introduction

A lot of research has been done to make machines identify human emotions by using complex artificial intelligence systems. There are different types of systems used for different purposes like making decisions, robotics, expert systems, etc. The models are trained using deep learning techniques like recurrent neural network, convolutional neural network, attention network and so on. Some systems combine various classification models using hybrid models. Nowadays, hybrid methods and adaptive methods are also adopted to understand human natural language. Such systems can learn for themselves over a period of time by accessing all the data available online. They provide positive results for emotion recognition and a human user can ask questions to these systems in the same way as one would to another human[1].

Some of the currently available chat bots for assistance are Apple Siri, Google Allo, Microsoft Cortana, etc. These services serve to user queries and provide useful answers but they use only Natural Language Processing(NLP) and cannot react to emotional questions. Some of the chats bots available in market which provide emotional assistance are Woebot, Pepper.ai, Wysa, Joy, Evei. In this paper, an online chat bot called Bot - Autonomous Emotional Support(BAES) is introduced which will help to uplift the mental state of depressed people. An advantage of BAES over other chat bots is that it will be open source and identify with users way of replying over a period of time. BAES will match the input from user with the data gathered about that user from various social networking websites. As it is an adaptive chat bot, the replies will get better as more data is collected. BAES can understand English and Hindi-English languages which makes it easier for Indian public to use.

Lately, many people are undergoing depression without them realizing it. Any mental condition is still not considered as an illness in various parts of the world and often goes unattended. People do not even understand that they are going through depression

since it is somewhat of a taboo to talk about mental illness and so, people end up committing suicide. Also, the cost of counseling from experts like psychiatrists, psychologists is very high[2]. To provide a cheap and effective way to treat this, open source chat bots need to be encouraged. People might start feeling lonely and isolated, and this is when they can easily access chat bot for comfort and counseling when they have no other person to go to. Thus, we have provided a solution which will tend to the mental state of the user and which will assist each one personally depending on the data of user. BAES will try to remind a depressed person of his/her achievements, which have been shared on social media or given directly to the bot, to pacify him/her and try to make him/her feel better about himself/herself. This will lead to improved mental health and mental satisfaction of the user and will provide a support whenever needed.

The rest of the paper is structured as follows: Section 2 describes the previous work that has been done in this particular domain. Section 3 discusses about the methodology and approach proposed in this paper to help people get over depression. Section 4 throws a light on the setup required to build and use this application and provides results of the partial work done. Section 5 gives an idea of this bot with its partial implementation. Finally, the paper is wrapped up with the benefits of BAES over other chat bots and its future scope for actual implementation.

2 Literature Survey

Bayu Setiaji, Ferry Wahyu Wibowo have proposed in [1] that their chatbot would match the input sentence from the speaker or user with pattern that has existed on the knowledge database. Each pattern is paired with the knowledge of chatbot which is taken from various sources. When connecting chat application to the database, it can miss in defining a sentence and how to respond to it. So knowledge representation in the database tables and implementation of structured query language (SQL) in the pattern-matching operation are very needed. Data which has been modeled on the pattern of the conversation would be tested using a series of scenarios. The results of conversation with the chatbot

would be crosschecked with the basic pattern. A natural language processing (NLP) gives capability to computer to allow communication to happen between user-to-computer or human-to-machine and computer-to-computer or machine-to-machine using human natural languages. There are three analyses to understand natural language : parsing, semantic interpretation, and knowledge-based structures.

In [3], the authors have proposed an approach to machine translation based purely on neural networks showing promising results compared to the existing approaches such as phrase- based statistical machine translation known as neural machine translation. There is a major limitation in NMT in which the number of target words must be limited because the complexity of training the model and using NMT model increases as the number of target words increases. Sebastien Jean, Kyunghyun Cho, Roland Memisevic,and Yoshua Bengio introduced a method based on importance sampling that enables us to use a huge target dataset without increasing training complexity.

The approach of a novel neural network model called RNN EncoderDecoder that consists of two recurrent neural networks (RNN) is proposed by Kyunghyun Cho et al. in [4]. One RNN encodes a sequence of symbols into a fixed-length vector representation, and the other decodes the representation into another sequence of symbols. The encoder and decoder of the model are trained together to maximize the conditional probability of a target sequence when a source sequence is given. The qualitative analysis shows that it can capture the spoken input data and its regularities and explain the quantitative improvements in the overall performance. The further analysis of the model reveals that the RNN EncoderDecoder learns a continuous space representation of a phrase that preserves both the semantic and syntactic structure of the phrase.

The conversational service can provide personalized counseling service to individuals head-to-head. It is important to resolve the isolation of the patients who have a mental disorder such as depression and lethargy. One-to-one conversation can resolve the isolation effectively. Personal dialogues can also operate efficiently when a user needs urgent interventions. In the early study[5], Kyo-Joong Oh et al. developed simple chat bot that provide interventions about subsequent behavior change for young adults alcohol risk. They give the interventions based on three item questionnaires

about drinking habits via alcohol consumption level and frequency of drinking by internationally well-known as AUDIT-C. They proposed an application of counseling chatbot, which provides conversational service for mental health care based on emotion recognition methods and the chat assistant platform.

3 Proposed Methodology

Chatbots tend to fail when encountered with an unknown statement. This can be solved by manually typing responses for all the possible statements. However, this would make the database bulky and its impossible to think of every possible statement. This gets solved by tensorflow Seq2Seq model which tries to generate response for every statement. The network architecture of tensorflow model is a standard encoder/decoder with 3 LSTM layers (hidden size of 256) [6]. The network is trained using ADAM. The maximum sentence length is set to 10 words, but can be increased. This makes generating response for unknown statements fast and easy. It is also less bulky and faster than previous approach. However, the model cannot be trained to fixate a response for certain statements. The responses based on tensorflow are heavily dependent on the dataset it is trained on. This enabled us to integrate a users chat history data from his/her social platforms. It provides our chatbot a flavor of the users personality and makes the responses more interesting to the user.

Our approach has integrated both, tensorflow based responses and database based responses through ChatterBot library [7]. This enables our chatbot to be prepared for certain statements of a depressed person, remind user of his self-told achievements, deal with out of context statements as well as map responses to users way of chatting. The figure 1 depicts the architectural diagram of proposed work.

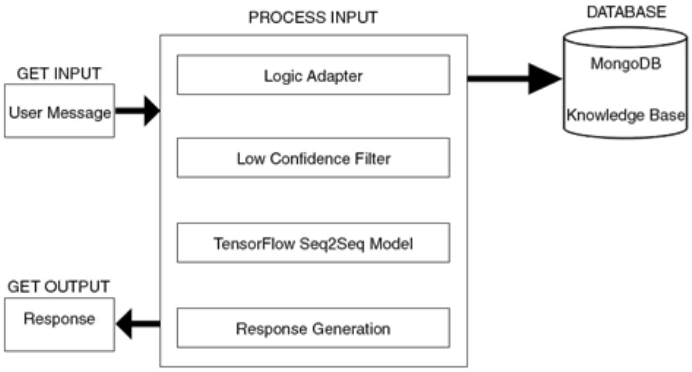

Figure 1: Block Diagram of proposed work

As you can see in figure 1, the logic adapter does 2 things: (1) Selects a known statement from database that most closely matches to input statement, (2) Returns a known response to the selected match and a confidence value based on the matching. The low confidence filter has a set threshold of about 0.65 which decides to output the response based on database or forward it to tensorflow.

4 Experimental Setup

Hardware requirements are minimal for user. However, hardware requirements for server are higher end. Hardware Requirement (Server): CPU: Intel i5 or better, RAM: 4 GB or better, OS: Windows 7 or better, VIDEO CARD: NVIDIA Graphics Card with minimum 1 GB memory, FREE DISK SPACE: 3 GB.

Software Requirement for user would involve only a browser but the requirements for server are mentioned as follows: Python 3.5.2, CUDA Toolkit 8.0, Chrome Webdriver, PhantomJS.

Following libraries in python: setuptools, requests, django debug toolbar, Django, pack-aging, selenium, ChatterBot, django braces, beautifulsoup4, django model utils, uvloop, websockets, wheel, tensorflow, tensorflow-gpu, numpy, nltk, tqd.

With the above requirements, the current setup starts with user being navigated to django local server URL. The homepage contains

a login screen and if its first time login then user is asked if he/she wants to use his/her social media chat history data for BAES. If provided, the raw chat data is converted to sequence of question and answer format. Currently, whatsapp & facebook chat history data is used.

5 Implementation

The server starts learning with the inclusion of users chat data in its existing base dataset as shown in figure 2

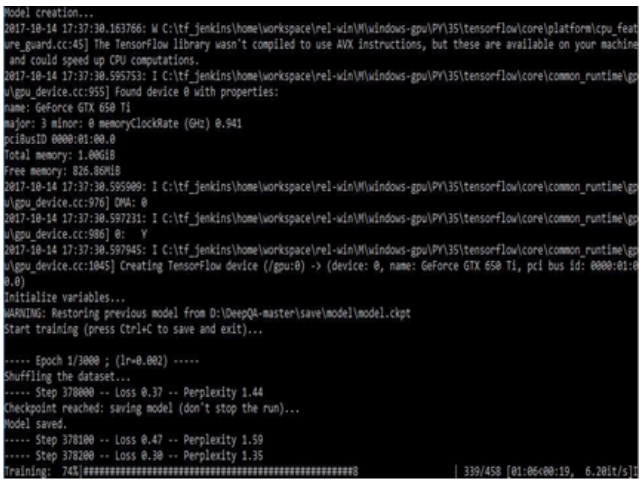

Figure 2: Training Snapshot

It takes 3-4 hours to achieve a considerable learning growth with Tensorflow Seq2Seq Model parameters as shown in figure 3 Once the training is complete, the model is ready for testing. However, this model is utilized to generate a response only when the statement provided by the user is unknown. If a known statement is provided as per the statement response documents stored in MongoDB, then the response is fetched. A sample of MongoDB document stored is shown in figure 4.

This database is indexed on text key for faster searching of database. The statement provided and texts stored in database

is compared using levenshtein distance algorithm. Levenshtein distance (LD) is a measure of the similarity between two strings, which we will refer to as the source string (s) and the target string (t) [8].

```
[General]
corpus = lightweight

[Dataset]
datasettag = raw-3
maxlength = 10
filtervocab = 1

[Network]
hiddensize = 256
numlayers = 3
softmaxsamples = 0
initembeddings = True
embeddingsize = 64
embeddingsource = GoogleNews-vectors-negative300.bin

[Training]
learningrate = 0.002
batchsize = 32
dropout = 0.9
```

Figure 3: Model Parameters

```
> db.statements.findOne()
{
        "_id" : ObjectId("59c5788446b0b5915beb94fd"),
        "text" : "Hello",
        "in_response_to" : [
                {
                        "text" : "Hi",
                        "created_at" : "2017-09-23T02:24:28.330400",
                        "occurrence" : 9
                },
                {
                        "text" : "Greetings!",
                        "created_at" : "2017-09-23T02:24:28.332402",
                        "occurrence" : 9
                }
        ],
        "created_at" : "2017-09-23T02:24:28.327398",
        "extra_data" : {

        },
        "occurrence" : 18
}
```

Figure 4: MongoDB Document

The distance is the number of deletions, insertions, or substitutions required to transform s into t. A low confidence threshold is set to decide whether a statement is known or unknown. An un-known statement is processed by Tensorflow model to generate a response. The implementation results can be seen in figure 5. An obvious statement containing depressed or similar words is responded with responses from database. However, an unprecedented statement is replied by tensorflow model such as that in regional language of user.

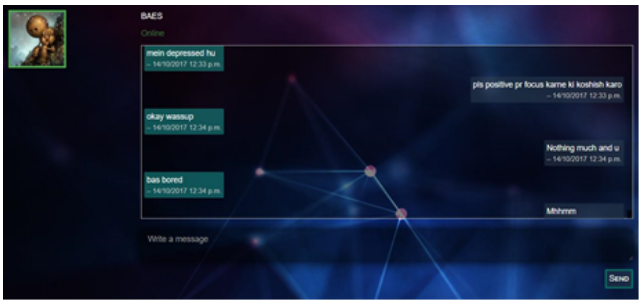

Figure 5: Responses of BAES chatbot

6 Benefits

With technological advancements, depression rates are increasing at a faster pace. Depression is not accepted as a normal disease over the world. According to World Health Organization, 121 million people are affected by depression worldwide. Developed countries like US top this list[9]. In India, over 5 crore people are suffering from depression whereas the count of psychiatrists in India is terrible. It is almost half of the number which should be actually present[10]. According to a survey, humans are more likely to open up before machines rather than humans. With our proposed idea, we are trying to create a virtual model of psychiatrist. We are developing a chatbot system which will act as a minimal psychiatrist reaching out to an upset person.

The benefits of this system include: a lonely person having a smart phone can reach out and share their emotional state, anytime

& anywhere, with the bot. It will be free of cost which will attract anyone to at least give it a try. The chat bot wont judge a person on the basis of his failures. A chat bot can make it easy for a person to lift a weight off his/her heart. The chat bot will have an implicit NDA and keep the chat log in database. It will help to remind a person for his/her own worth by revisiting some of the achievements of the user. It would be able to talk like the user based on provided chat history of user which would make it friendly & interesting.

7 Conclusion

Now-a-days chat bots are looked at from an assisting approach. This makes them unable to establish any friendly connection with the user. Also, purely AI chat bots do not have set responses for set statements. Our approach will provide a response based on users way of chatting as well as based on positively prepared responses. A study introduced a personalization framework using long-term memory[11]. Another study used word2vec to generate natural sounding phrases[12]. This will help establish a friendly connection with the user as well as provide positive thoughts to user. If the user keeps giving negative response over time, the chat bot can have a functionality to alert the users close ones.

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