BOBtheBOT: An Intelligent Chatbot to Detect Mental Illness by Recognizing Emotion Through Text

Ashwin
Department of Computer Science and Engineering,
Sree Buddha College of Engineering, Pattoor,
Alappuzha, Kerala, India - 690529
Email: Ashwindavid11@gmail.com

Vidya Prasannan
Department of Computer Science and Engineering,
Sree Buddha College of Engineering, Pattoor,
Alappuzha, Kerala, India - 690529
Email: Vidyaprasannan1999@gmail.com

Megha P S
Department of Computer Science and Engineering,
Sree Buddha College of Engineering, Pattoor,
Alappuzha, Kerala, India - 690529
Email: Gem.ps14@gmail.com

Vishnu B Dev
Department of Computer Science and Engineering,
Sree Buddha College of Engineering, Pattoor,
Alappuzha, Kerala, India - 690529
Email: Bdevbdevbdev@gmail.com

Lakshmi S
Assistant Professor
Department of Computer Science and Engineering,
Sree Buddha College of Engineering, Pattoor,
Alappuzha, Kerala, India - 690529
Email: Lakshmi.rnath@gmail.com

A*bstract* – A chatbot is an intelligent piece of software that is capable of communicating and performing actions similar to a human by artificially replicating the patterns of human interaction. It allows a form of interaction between a human and a machine. Social chatbots are designed to form a social-emotional relationship with the end user. The main notion behind this chatbot is to predict if the user has an underlying mental health issue. This paper provides a solution as a system which can communicate and find the intensity of various emotions such as joy, sadness, fear, anger, guilt, disgust, shame. Further, based on the obtained intensity of each emotions, the chatbot predicts if the users suffering from mental illness by using users chat data. The chatbot uses Long–Short Term Memory (LSTM) for emotion detection.

Key words: Artificial Intelligence, Mental Illness, Chatbot, Emotions.

I. INTRODUCTION

Chatbots are special agents that respond with the user in natural language just as a human would reply [1][7]. Pointedly, social chatbots are the ones which builds a strong emotional relationship with the user [1]. The primary goal of a social chatbot is not necessarily to solve all the questions the users might have, but rather, to be a virtual companion to users [4].

Early conversational systems, such as Eliza (Weizenbaum, 1966), Parry (Colby, 1975), and Alice (Wallace, 2009), were designed to mimic human behaviour in a text-based conversation, hence to pass the Turing Test (Turing, 1950; Shieber, 1994) within a controlled scope [5][6]. Despite impressive successes, these systems, which were precursors to today's social chatbots, were mostly based on hand-crafted rules. As a result, they worked well only in constrained environments.

In the area of mental health, there are still open questions about how to use technology to sense affective states of mind [4]. A recent analysis implies that many people may actually would rather "talk" to a chatbot or other AI program about their mental health struggles than to a therapist themselves. In fact, only 18% of people surveyed preferred to talk to a human about their problems, meaning that 82% would prefer to talk to a robot [7].

In this paper, we proposed an intelligent chatbot which can help to detect the intensity of emotions in textual data from users' chat. Likewise, the bot can suggest whether the user needs an immediate medical attention, for that the user needs to converse with the bot, in this process the bot will try to form a bond between itself and the user. Based on the chat data collected from the conversation the bot will try to identify the emotion associated with each text. Subsequently, the overall intensity of each emotions will be calculated and whether the user is suffering from a mental illness is predicted.

The two algorithms are used in the model training. Long short-term memory (LSTM) is used for chatbot training while emotion analysis is done using Linear Support Vector Machine (LSVM). LSTM is applicable to tasks such as unsegmented, connected handwriting recognition, speech recognition and anomaly detection in network. A common LSTM unit is comprised of a cell, an input gate, an output gate and a forget gate [8]. LSVM on other hand is particularly suited for use with wide datasets, that is, those with a large number of predictor fields [9].

ISBN: 978-93-5473-994-1

These two algorithms are deployed further for completing the training.

II. RELATED WORKS

Continual refinement of emotion recognition and natural language processing techniques has allowed for chatbot systems to be successfully used in therapy and counselling.

One study attempted to redefine emotion recognition by distributing text into emotion labels and based on the labels it identifies users' mental state as stress or depressed using users' chat data. Further, based on the emotions, it calculates the positivity and negativity percentage to classify the mental state of the user using negativity percentage. For emotion detection, they deployed three popular deep learning classifiers namely, Convolutional Neural Network (CNN), Recurrent Neural Network (RNN), and Hierarchical Attention Network (HAN) [1].

Another approach to textual emotion analysis was by building an emotion embedding model using Convolution Neural Network. In this paper, a further classification of emotion is added so as to provide more descriptive output from the model. Emotions embedding model here only refers to an embedded layer trained in CNN emotional classification learning process and cannot identify the presence of emotion shift in statements [2].

A different research summarized many recent advances and several key research challenges associated with NLP research area. It suggests an effective emotion-shift recognition model and context encoder can yield significant performance improvement over chit-chat dialogue, and even improve some aspects of task-oriented dialogue [3].

III. PROPOSED METHOD

In this work, we proposed a chatbot which takes users' chat as input and predicts the percentage of various emotions such as Joy, Shame, Anger, Disgust, Sadness, Guilt, and Fear involved in it. The chatbot is trained to handle simple conversations and meanwhile passing the users' chat to emotion detection model which classify the users' chat into the emotions mentioned above and further based on this classification, the percentage of each emotion is calculated by taking the total number of conversations into account.

A. Dataset Description

In this work, we have used the International Survey on Emotion Antecedents and Reactions (ISEAR) dataset for emotion detection from the chat text. The dataset consists of 7652 phrases and 1542 emotional words. It is categorized into several categories of emotions such as Joy, Shame, Anger, Disgust, Sadness, Guilt, and Fear.

The dataset used for chatbot is a collection of YAML files with each of them handling various contexts in the conversation.

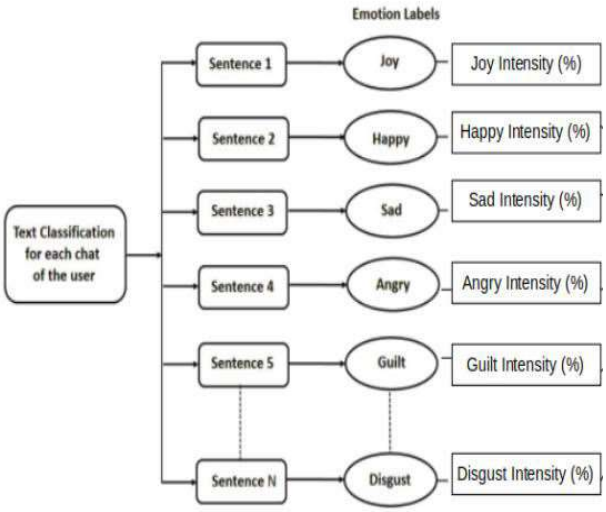

Fig 1.1: Proposed model

B. Training and Testing

We trained and tested two models. One for emotion detection and the other for chatbot. To identify the emotion from text, LSVM algorithm is deployed. And the chatbot is trained with LSTM, a deep learning algorithm.

i. Emotion detection model

a) Data cleansing: This process involves removing unwanted characters, converting entire text into lowercase, spelling correction, rare word removal and the removal of stopwords using NLTK.

b) Label Encoding: The emotion label corresponding to each sentence of the dataset is encoded into integer values.

c) Splitting the dataset: The dataset is split into two for training and testing in a 9:1 ratio.

d) Lemmatization: This process groups together the inflected forms of a word so they can be analysed as a single item. Word.lemmatize() function in the TextBlob package is used.

e) Forming Word Vector: Scikit-learn's CountVectorizer is used for obtaining vector representation for words. It is used to transform a given text into a vector on the basis of the frequency of each word that occurs in the entire text.

ISBN: 978-93-5473-994-1

f) Training: The LSVM Model is trained with SGDClassifier followed by testing. An accuracy of 56% is obtained.

ii. Chat-Bot Model

a) Data Pre-processing: As Deep learning techniques are used for the training of the chat model, there are only few pre-processing done manually to the dataset. The collection of YAML files is converted to a single YAML file. These data are then tokenized.

b) Label Encoding: The intent corresponding to each conversation text is encoded into integer value.

c) Training: The model is trained using the LSTM model and an accuracy of 99% is achieved.

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 20, 16)            16000
_________________________________________________________________
global_average_pooling1d (Gl (None, 16)                0
_________________________________________________________________
dense (Dense)                (None, 16)                272
_________________________________________________________________
dense_1 (Dense)              (None, 16)                272
_________________________________________________________________
dense_2 (Dense)              (None, 14)                238
=================================================================
Total params: 16,782
Trainable params: 16,782
Non-trainable params: 0
_________________________________________________________________
```

Fig 1.2: Chatbot Model

C. Emotion Percentage Calculation

After the training and testing of both the model is completed, the two models are pipelined together in such a way that the users' chat input is first fed into the emotion detection model and the result is stored till the end of the chat.After this, the users' chat input goes to the chatbot model itself from where the model finds the apt reply output by calculating cosine similarity between the sentences which belongs to the same intent as the input.

The chatbot stops taking input after receiving the 'quit' command. At this stage, all the results stored by the emotion detection model are now used to calculate the percentage of each emotion.

$$Emotion\ percentage(joy) = \frac{Emotion\ count(joy)}{Total\ no.of\ chat\ sentences}$$

The calculated percentages are finally printed on the screen as output.

IV. CONCLUSION

In this paper we proposed an intelligent chatbot for detecting user's emotion and to predict whether there is an underlying mental health issue. For the purpose of analysing emotions from user's text, machine learning algorithm namely, LSVM was deployed. Furthermore, deep learning algorithm namely, LSTM was used for chatbot training.

When any type of mental health or emotional concern affects daily life and function, it is important for people to choose to seek help on their own. But most often people don't recognize if there is anything worth of a concern. The chatbot promotes a mode to make the user understand the problem that they themselves wasn't able to.

Whether AI chatbots can become a placeholder for emotional relationship with real humans is still a question but already, AI researchers and robotics are developing products for exactly this purpose, testing the limits of how much a machine can learn to mimic and respond to human emotions.

V. REFERENCES

[1] Falguni Patel, Ishita Nandwani, Riya Thakore and Santosh Kumar Bharti, "Combating Depression in Students using an Intelligent ChatBot: A Cognitive Behavioral Therapy", 2019 IEEE 16th India Council International Conference (INDICON).

[2] Seo-Hui Park, Byung-Chull Bae and Yun-Gyung Cheong, "Emotion Recognition from Text Stories Using an Emotion Embedding Model", 2020 IEEE International Conference on Big Data and Smart Computing (BigComp).

[3] Soujanya Poria, Navonil Majumder, Rada Mihalcea and Eduard Hovy, "Emotion Recognition in Conversation: Research Challenges, Datasets, and Recent Advances", 2019 IEEE Access, Vol.7.

[4] Asma Ghandeharioun, Daniel McDuff, Mary Czerwinski and Kael Rowan, "EMMA: An Emotion-Aware Wellbeing Chatbot", 2019 8th International Conference on Affective Computing and Intelligent Interaction (ACII).

[5] Kerstin Denecke, Sayan Vaaheesan and Aaganya Arulnathan, "A Mental Health Chatbot for Regulating Emotions (SERMO) - Concept and Usability Test", 2020 IEEE Transactions on Emerging Topics in Computing.

[6] Lin, Z., Xu, P., Winata, G. I., Siddique, F. B., Liu, Z., Shin, J., & Fung, P, "CAiRE: An End-to-End Empathetic Chatbot", Proceedings of the AAAI Conference on Artificial Intelligence, 2020 34(09), 13622-13623.

[7] Forbes. (2021, April 2). Opening up to a robot? How mental health tech can help patients [Online]. Available: https://www.forbes.com/sites/forbestechcouncil/2021/04/02/openi

ng-up-to-a-robot-how-mental-health-tech-can-help-patients/?sh=7a033831722c

[8] Felix A. Gers, Jürgen Schmidhuber and Fred Cummins, "Learning to Forget: Continual Prediction with LSTM", Neural Computation, Volume: 12, Issue: 10, Oct. 1 2000.

[9] Shu-Xia Lu and Xi-Zhao Wang, "A comparison among four SVM classification methods: LSVM, NLSVM, SSVM and NSVM", Proceedings of 2004 International Conference on Machine Learning and Cybernetics.