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Emotion Guru: A Smart Emotion Tracking Application with AI Conversational Agent for Exploring and Preventing Depression

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Abstract—Mental health issues like depression and anxiety have been increasing among the population over the years. In Sri Lanka specifically people's happiness has seemed to decrease. This can be a reason for the increase in mental health issues. These mental health issues sometimes sadly result in suicide. One of the root causes of mental illness is the lack of understanding one has on their own emotions. To address the identified problem this research study proposed a solution by promoting emotional intelligence. The solution is an emotion tracking application that includes an AI conversational agent who will talk to users when they are mentally down and suggest ways in which they can improve their emotions based on their own previous experiences. The application will also allow users to analyse their weekly emotions by providing easy to understand charts and detecting their emotions from their social media posts. The empirical results show the machine learning model for the chatbot obtained an accuracy of 98.46%.

Keywords—Natural Language Processing, Sentiment Analysis, Chatbot, Emotion Detection, Mental Health.

I. INTRODUCTION

Mental health has proven become a big problem among our society. The World Health organization (WHO) has estimated that the global population suffering with depression is 4.4% and anxiety is 3.6% [1]. According to the Sri Lankan government findings, the estimated total cases of depression was 802,321 (4.1% of the population) and estimated total cases of anxiety was 669,259 (3.4% of the population) in 2015 [4]. Moreover, according to the Gallup Global Emotions report, the negative experience index has been rising over the past years [2]. The recent Word Happiness Report showed that Sri Lanka was ranked 129 out of 149 countries in happiness [3]. These factors have resulted in the deteriorating of people's emotional and mental wellbeing in society. One of the root causes of mental illness is the lack of understanding one has on their own emotions.

This paper aims to tackle this issue by promoting emotional intelligence. This is because research has found that individuals with more Emotional Intelligence experienced higher levels of belongingness which, in turn, was associated with lower overall mental health problems. The vice versa was for individuals with less emotional intelligence [5]. Therefore, an emotion tracking application can be a suitable solution for this problem as it will help individuals have a better understanding of their own emotions.

The main aspect of this application is the conversational AI agent (chatbot) named Joy. Joy will talk to the user when

the user is mentally down and will help them feel better by replying in an encouraging and positive manner. Joy will also suggest ways in which the users can improve their mood based on their previous inputs. If they express any thoughts of suicide, Joy will direct them to an emergency helpline and the app will send a warning text to their emergency contact (this can be their therapist or even a trusted friend or family member). Another aspect of this application will be the mood charts which will show users how their positive and negative emotions have progressed over the week. It will also show a comparison between their positive and negative emotions of the week. The app will also detect emotions from social media. It will analyse the users' Facebook posts and show them the positivity and negativity of their posts they have shared over the last 24 hours. The app will also show a list of mental health professionals that users can contact if needed.

For the implementation of the proposed solution we used Natural Language Processing, Sentiment Analysis and Neural Networks as the key technologies. The machine learning model for the chatbot obtained an accuracy of 98.46%. The sentiment analysis was done through the TextBlob library in Python which uses the Naive Bayes classification technique to obtain the polarity of a textual statement.

II. LITERATURE REVIEW

A. Technologies Used for Mental and Emotional Wellbeing

1) Mental Health Mobile Apps

Mental health apps offer various approaches to improve mental health. The approaches include relaxation, stress management, symptom tracking, calming audio, keeping a diary, connect with mental health resources, interpersonal support, meditation, and mood [6]. For depression specifically, the use of cognitive behavioural therapy (CBT), mindfulness training, mood monitoring, and cognitive skills training has proven to be useful [7].

Based on organisations relating to public health, applications developed to cater for mental health are often times budget-friendly and feasible when compared to generically followed treatments. In 2015, the World Health Organization carried out a survey of 15,000 mobile health apps, it found that 29% of these apps focused on mental health diagnosis, treatment, or support [8].

2) Chatbots in Mental Health

Chatbots are another common technology used in mental health. A chatbot can be defined as "as digital tools existing either as hardware or software that use machine learning and

artificial intelligence methods to mimic humanlike behaviours and provide a task-oriented framework with evolving dialogue able to participate in conversation” [9].

The insufficient amount of mental health services has prompted the use of technology in order to meet the needs of people affected by mental illnesses. One of the main technological solutions for mental health is the use of chatbots also known as conversational bots. In fact, the first-ever chatbot, ELIZA was developed in a way that she would respond to messages as though she was a psychotherapist. The ELIZA project was very successful in that users of the program felt that Eliza had a genuine understanding of them and would spend long sessions on the computer ‘talking’ things through [10].

According to the MIT Technology Review, one of the top requests to Alexa during the summer of 2017 was “Alexa, help me relax” [11]. This shows that many people are looking for help through these kinds of technologies. Chatbots have been shown to encourage interaction by people who are generally reluctant to seek mental health advice due to stigmatization [12]. Due to these factors, a chatbot feature was added to this app in order to have a more personal way of improving a user’s emotions.

A chatbot uses natural language processing along with artificial intelligence in order to understand and respond to users. The user will first send a message to the chatbot expressing their feelings, this message will then be processed through NLP and AI algorithms and will come up with an appropriate response based on the dataset.

3) Emotion Detection

Emotion recognition is the process of identifying human emotion. It is used to automatically classify an individual’s temporal emotional state by basing on some input data [13]. Cheng et al., (2020) states that “Emotion recognition enables real-time analysis, tagging, and inference of cognitive-affective states from human facial expression, speech, and tone, body posture, and physiological signal, as well as social text on social network platform”. Emotion recognition is critical when detecting and diagnosing patients with mood disorders. Physiological emotion recognition, textual emotion recognition, facial expression, and speech emotion recognition are some of the subfields under emotion recognition. For the proposed solution, textual emotional recognition was used. This is because, many people seem to find easier express their emotions through text, rather than talking.

A text analysis of 63 Internet forums (over 6400 members) using the Linguistic Inquiry and Word Count, found elevated levels of absolutist words in depression recovery forums. This seemed to suggest that absolutist thinking may be a vulnerability factor for relapse of mood disorder [14]. Moreover, a study that included 166 individuals and 43,950 participant Instagram posts, analysed textual and visual features from these Instagram posts. The study concluded that depressed people are more likely to upload photos that are bluer, grayer, and darker [15].

Sentiment analysis is commonly used in text-based emotion recognition. Sentiment analysis (or opinion mining) is a natural language processing technique used to determine whether data is positive, negative, or neutral. [16]. An application developed in China, involved the integration of sentimental analysis in order to produce a depression detection

model for micro-blog social media, with the purpose of detecting individuals who might be undergoing a depressive phase solely based on the behaviour that they project on social platforms. This technology will help detect the rate/frequency of the individual’s social media input alongside communication among other social media users and emoticons. The application provides two unique functionalities in which the first one will help identify if a user’s online presence is either positive or negative based on the mentioned sentimental analysis method. This method will be used to calculate the polarity of each fragment with regards to a micro-blog. Based on this method, the user can be concluded being either “very optimistic”, “a little optimistic” or “pessimistic” based on their weekly activity with regards to the current micro-blogs. The other function is to analyse whether the given user is inclined to be depressed or not. If a user is tested to be depressed, the application also provides diagnostic messages including some suggestions from the psychologists on active self-regulating strategies [17].

Our research study aims to use sentiment analysis in order to help users have a better understanding about their emotions being represented on their social media feed. The application will show a user how positive and negative their feed is so they can be more self-aware about how their emotions are being portrayed on social media and therefore increase their emotional intelligence. This application varies from other mental health applications because it specifically targets improving one’s emotional intelligence in order to prevent mental health issues like depression.

III. METHODOLOGY

A. Proposed Architecture

Considering the above literature review our research hypothesis was composed, where an emotion tracking application can help to address the identified research problem. In this application, the emotion patterns of an individual, will be analysed based on their regular activities.

The following points help summarize the main research contributions of our study,

- Daily log of user’s emotions and activities related to those emotions
- If a user is having negative emotions, an AI-integrated chatbot will suggest activities for the user to do that have given them positive emotions in the past.
- A mood analysis chart which will be compiled at the end of each week in order to will provide an analysis of the overall emotional well-being of the user.
- Emotion detection and analysis of users’ social media feed.

B. Implementation

1) Dataset

The training dataset for the chatbot was gathered from Kaggle [20]. This was a dataset used for a counselling chatbot. A few more intents were added to this dataset in order to make it more catered to the application. This dataset can later be improved more by getting advise from mental health professionals who can give a better understanding on how to respond to a user who is feeling down. The dataset consists of 14 classes relating to common emotions people face on a day-to-day basis. These classes all include possible patterns in

which people text and relevant responses to texts. This dataset will be further improved later by adding more classes.

2) Chatbot

Figure 1 shows the architecture diagram of the overall outline of the chatbot system. A REST API has been used to connect the frontend and the backend of the system. The architecture of the system is as follows.

When training the chatbot prediction model, a dataset with intents that are common emotions/moods were used. In order to use this dataset to train the model, the words in the dataset were tokenised (breaking text into individual linguistic units) and stemmed (removing the suffix from a word and reduce it to its root word). This was done with the NLTK library in Python. Next, a bag of words needs to be created. The bag-of-words model is a representation that turns arbitrary text into fixed-length vectors by counting how many times each word appears. This is done by going through all the items in the words list and if the word is identified in the patterns, it will be flagged as one. The final training set is then created by having an output array which will be a list with 1 flagged for the current intent and 0 flagged each of the other intents.

TFLearn was used to create the model. Through TFLearn a deep neural network can create a predictive model from the sentence patterns defined in the dataset. Since TFLearn uses numpy arrays, the final data was converted into numpy arrays. Then the dataset is divided into the input data array and possible outcome arrays for each input. A neural network is then defined by setting its shape and the number of layers. The trained model will then be used when a user sends a message to the chatbot.

First, the input message will be converted into a bag of words. This bag of words will then be passed into the model trained previously in order to get a prediction of what the intent (eg: a greeting) is. A random response from the dataset corresponding to the intent will be sent back. If the intent is equal to ‘suicide’, a text will be sent to the user’s emergency number informing them that the user is feeling suicidal. If the intent is ‘sad’ then along with random response, based on a user’s previous inputs a random activity that has made them happy in the past will be suggested by the chatbot.

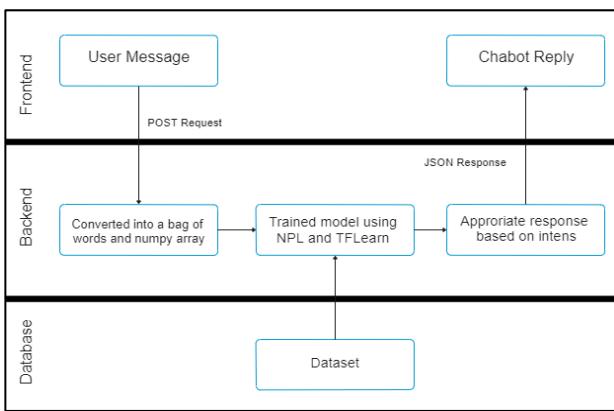


Fig. 1. Chatbot architecture diagram

3) Mood Charts

Users will be able enter their emotions anytime they want. Based on these entries, the application will display charts that can help analyse one’s emotions over the past week. Line charts showing user’s how their positive and negative emotions have progressed over the past 7 days will be

displayed along with a pie chart comparing the frequency of their positive and negative emotions. The chart.js library was used to plot this data. Figure 2 are the moods charts generated for a specific user,



Fig. 2. Mood charts showing how the user’s emotions have progressed over the last 7 days and comparison of their positive and negative emotions

4) Emotion Detection Through Social Media

The application specifically uses Facebook to detect emotions. The application will send a request to the Facebook API first to authenticate the user and retrieve the user’s access token. The user will be then prompted to give permission for the application to access their username and timeline posts. Once a user allows access to their Facebook profile, the user’s timeline posts are retrieved using their access token. Then, using the Textblob library in Python, the sentiment polarity of each post will be calculated. If the polarity of the post is less than 0 one then it will be classified as negative and if the polarity greater than 0 it will be classified as positive. For each post that is positive, 1 will be added to a positive counter and for each post that is negative, 1 will be added to the negative counter. These counters will be plotted on to a bar chart and will be displayed to the user. Figure 3 is a screenshot of the bar chart, showing the logged in user of the positivity and negativity of their Facebook timeline,

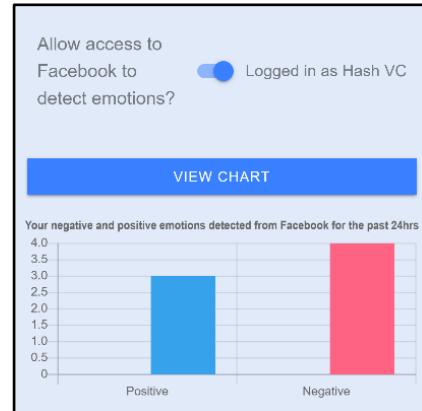


Fig. 3. Emotion Detection from Facebook

IV. EVALUATION

A. Experimental Setup

TABLE I. EXPERIMENTAL SETUP

PC Model	Lenovo Ideapad 330S-15IKB
Processor	Intel(R) Core(TM) i3-5005U CPU @ 2.00GHz 2.00 GHz
RAM	8GB
GPU	Not available

B. Evaluation Metrics

Below are the metrics used to evaluate the machine learning model of the chatbot,

- Precision - Precision is the proportion of predictions of that class that are true. Higher precisions indicate a more accurate the model is. The equation for precision is,

$$\text{Precision} = \frac{\text{TruePositives}}{\text{TruePositives} + \text{FalsePositives}} \quad (1)$$

- Recall - Recall is the proportion of the true positives that are identified as such. Higher recall indicate a more accurate the model is. The equation for recall is,

$$\text{Recall} = \frac{\text{TruePositives}}{\text{TruePositives} + \text{FalseNegatives}} \quad (2)$$

- F1-score – This is an average of the precision and the recall. The equation for the F1-score is,

$$\text{F-Measure} = \frac{2 * \text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}} \quad (3)$$

- Support – Represents the occurrence of the given class in the dataset.

C. Evaluation Results

The machine learning model for the chatbot has an overall accuracy of 98.46%. Figure 4 is the classification report that shows the prediction accuracy of each class (intent),

	precision	recall	f1-score	support
angry	1.00	1.00	1.00	4
anxious	1.00	1.00	1.00	5
break	1.00	1.00	1.00	4
failure	1.00	1.00	1.00	3
family	1.00	0.67	0.80	3
greeting	1.00	1.00	1.00	5
lonely	1.00	1.00	1.00	3
sad	1.00	1.00	1.00	4
self_hate	1.00	1.00	1.00	2
selfesteem	0.75	1.00	0.86	3
stressed	1.00	1.00	1.00	3
suicide	1.00	1.00	1.00	6
ugly	1.00	1.00	1.00	7
unliked	1.00	1.00	1.00	4
accuracy		0.98	0.98	56
macro avg	0.98	0.98	0.98	56
weighted avg	0.99	0.98	0.98	56

Fig. 4. Classification Report of the chatbot model

- Precision - 100% of the predictions for each of the classes except the ‘selfesteem’ class are actually of the predicted class. In the ‘selfesteem’ only class 75% the predictions are of the predicted class.
- Recall - The model is correctly identifying 100% of all classes but only 67% of the class ‘family’.
- F1-score – Apart from the ‘family’ and ‘selfesteem’ classes, all other classes have an F1-score of 100%.

Figure 5 is a snippet of a conversation with the chatbot. The chatbot replies in an empathetic manner and suggests activities for the user to do which has given them positive.

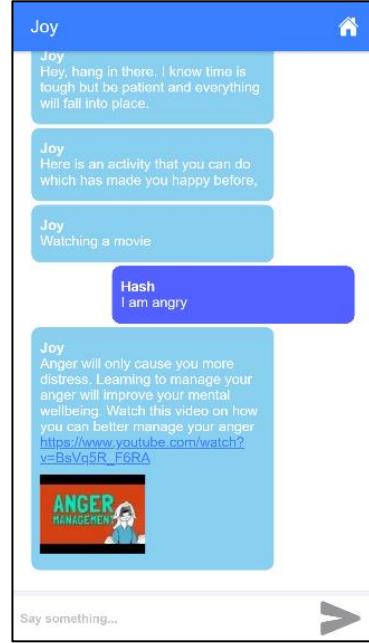


Fig. 5. Conversation between a user and the chatbot, Joy

D. Discussion

There are currently many mood tracking applications on the Google Playstore and the Apple App Store [19]. Users tend to use these apps because they want to learn about their mood in order to find strategies to improve, cope with stress, and manage mental illnesses. Many users pursue these goals by collecting data frequently, registering contextual information through notes, and sharing their data with healthcare providers. Still, they wish for additional features, such as the ability to personalize mood options, process their data for analysis, secure data to preserve privacy, and features specifically for particular conditions. It was found that both the general population and consumers with mental conditions used these mood tracking apps [18].

When comparing features of the current mood tracking apps available, it can be seen that none of the apps have the feature of detecting emotions through social media. This feature is however present in this application because social media has become a large part of most of our lives and we tend to use it very often to express our emotions. Therefore, having an app that will detect emotions will be helpful when identifying and analysing one’s emotions. Moreover, the only app that suggests activities to improve one’s emotions based on their past experiences is MoodPatterns. However, users

have complained that the mood charts on this app can be complicated and they weren't able to easily use the charts to analyse their moods. In order to make the app easy to use and understand, this application will suggest activities that will improve a user's emotions through a conversational chatbot so that the user can feel like they are talking to someone and therefore make them feel less alone. The mood charts are also simple and easy to understand. It just shows a user the comparison between their negative and positive emotions and how they have progressed over the last 7 days.

When dealing with sensitive information like a person's mental health, the risk of users expressing suicidal thoughts to the chatbot arises. In attempts to minimize this risk, if a user expresses that they are having suicidal thoughts, the chatbot will direct them to an emergency hotline as well as send a text message to an emergency contact of the user, informing them that the user is having these thoughts. (The user will need to add an emergency contact when registering for the application).

Data gathered from users through this application will not be shared among any third party. Users' passwords are encrypted and salted before it is added to the database.

V. CONCLUSION

The goal of this project was to develop a smart emotion tracking application. The problem identified in this project was the mental health issues faced by society today. An extensive background research was then carried out in order to identify an effective solution for this. Through research it was found that one of the reasons for mental health issues is having a low emotional intelligence. Therefore, the solution that was proposed for this is an emotion tracking application that will help users understand and handle their emotions better. This application includes a chatbot that will talk to users when they are down and offer encouraging messages and ways to improve emotions based on a user's passed experience. It also presents user's with their mood charts for each week so they can have a better understanding about how their emotions progressed over the week. Moreover, the application also is able to detect emotions from a user's social media posts and show the positivity and negativity of their online persona. The application was implemented using the Ionic Framework and Python Flask.

A. Limitations and Future Enhancements

Below are the limitations of the application and how they can be improved,

- Analysing only 2 emotions, happiness and sadness – This can be improved by adding the rest of the basic emotions which are, disgust, fear, surprise, and anger.
- Only suggests activities that can improve a user's mood - Also suggest people and locations that gives the user positive emotions
- No direct contact to mental health professionals – Having a feature in which users can make appointments with mental health professionals directly through the application and they can share their mood charts with the professionals if their appointment is confirmed.

Moreover, with future enhancements the application can be made more interesting by having professionally verified

mental health exercises on the app, a more interactive user interface and emotion detection through facial recognition. The dataset also can be further improved with more intents based on advice from mental health professionals. Also in the social media feature, rather than detecting only the positivity and negativity of the user's feed, the application can be further improved to also detect exact emotions like happy, sad, angry, calm, etc. It will also be beneficial if the application had a feature where if a user's moods do not improve over time for more than two weeks, the user will be advised and directed to making an appointment with a mental health professional for further help because having negative emotions for over 2 weeks can be an indication of a mental illness like depression,

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