Review on Analysis of Chatbot in Mental Healthcare

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Abstract:**To cure mental stress, the best manner is to speak concerning their feelings with somebody they trusty and unharnessed their pain inside them. The best thing somebody WHO is depressed will do is to achieve out and to speak concerning it before they act on their feelings.Chatbots are unit special agents that respond with the user in language even as a person's would reply. Specifically, social chatbots are those that establish a powerful emotional relationship with the user. The main construct behind this chatbot was to supply mental relief to students who bear totally different levels of stress. Associate in nursing which might be the onset of an unfriendly depression. A intelligent social therapeutic chatbot distributes the text into feeling. Further, supported the feeling label, it establish the users' mental state like stressed or depressed mistreatment users' chat data. For feeling detection, 3 fashionable deep learning classifiers to be deployed. The planned methodology of the chatbot is domain specific wherever through the users' interaction, the chatbot can attempt to forestall the bearish actions and reconstruct more constructive thoughts.**

Keywords*— *Artificial Intelligence, Chatbot, Conversational Agents, Depression, NLP, Sentimental Analysis, Students, Therapeutic chatbot, Voice Analysis.

I. INTRODUCTION

Stress and mental depression that area unit typically terms associated with class or class is rarely associated with university students not accepted as a standard illness over the world. Many folks die by suicide as a result of them didn't receive effective treatment. Depression is often caused by some ways, like a death of a loved one, a divorce or a breakup of a relationship, being victimized and physical abuse. Individuals longing depression typically feel fully alone. However, mental state advocates urge individuals to speak and provoke facilitate the best thing somebody World Health Organization is depressed will do, is to achieve out and to speak regarding it before they act on their feelings. There are help-lines/ crisis-lines for people who suffer and however several individuals provided. World Health Organization area unit considering suicide refrain from exploitation such services as a result of the concern and embarrassment they need in order to talk out for themselves. For these kinds of situations, there

has got to be a way for the people to express their emotions and feelings while not having higher than mentioned considerations. Sentimental analysis aims at distinctive the opinions of varied users. A positive opinion expressing text is appointed a positive label whereas a negative label denotes a negative opinion. Any objective opinion would be appointed a neutral label.

A malicious program that conducts a spoken communication with humans either in voice or matter technique is usually known as, a chatbot [1]. A chatbot or conversational agent (CA) is a software system that can interact or "chat" with a human user in natural language such as English. So, once programs convincingly imitate human as a schmoozer, it's aforesaid to pass the known Alan Mathison Turing Test.

In this paper, an intelligent therapeutic chatbot is proposed to reduce the mental disease (such as stress, depression) of youth. To beat from the mental disease, one has to be compelled to chat with the planned chatbot. During this, bot will converse and raise few inquiries to the user to know the matter. Based on the chat information, emotions of the user can be determined to calculate the share of negativity in chat. Further, with the help of negative content within the chat, classification of the extent of mental standing as traditional, stressed or depressed can be done. To extract the feeling from the user chat information, we have a tendency to deployed 3 well known deep learning algorithms particularly, Convolutional Neural Network (CNN)[6][7], repeated Neural Network (RNN)[8], and hierarchic Attention Network (HAN)[8].

An intelligent chatbot that takes user's chat because the input and when process, it'll provide the users'psychological state like traditional, stressed, or depressed. The planned chatbot is trained in such some way that once any user's chat fed into the chatbot then it classify the text into several emotions like Happy, Joy, Shame, Anger, Disgust, Sadness, Guilt, and Fear. Further, supported the emotions, it calculate the quality and negativity share of every chat text. Finally, a rule planned to classify the psychological state of the user victimization negativity share of mental standing as traditional, stressed or depressed.

II. DISCUSSION

Dataset description is the usage of ISEAR dataset is for feeling detection in text. The dataset consists of 7652 phrases and 1542 emotional words. It's classified into many broad categories of emotions like Happy, Joy, Shame, Anger, Disgust, Sadness, Guilt, and Fear to spot the feeling from text, 3 deep learning algorithms particularly CNN, RNN and HAN dynasty square measure deployed for training and testing.

Tokenization is a method which divides an entire text into a list of sentences by exploitation associate unsupervised rule to create a model for abbreviations, words, collocations, and words that start sentences. It should be trained on an oversized assortment of plaintext within the target language before it may be used. The tool used for acting tokenization is Punkt Sentence Tokenizer[19].

The unsupervised learning rule used for getting vector representations for words is international Vectors for Word illustration (GloVe). Training is performed on mass international word-word co-occurrence statistics from a corpus, and also the ensuing representations showcase attention-grabbing linear substructures of the word vector house. The GloVe model is trained on the non-zero entries of a world word-word co-occurrence matrix, which tabulates however oftentimes words go with each other in a given corpus. The tools provided during this package modify the collection and preparation of co-occurrence statistics for input into the model. The core coaching code is separated from these preprocessing steps and might be dead severally.

An embedding could be a mapping of a distinct categorical variable to a vector of continuous numbers. In neural networks, embedding term means that low-dimensional, learnedcontinuous vector representations of distinct variables. Neural network embedding square measure helpful as a result of they will reduce the spatial property of categorical variables and meaningfully represent classes within the remodeled area that reduce the complexness. Neural network embedding serves 3 primary purposes: [5]

1. Finding the closest neighbor in area that result in the formation of assorted cluster classes.
2. As an input to machine learning model for supervise learning.

3. For the relation between 2 classesi.e. how much difference is there between 2 words on the premise of their overacting distance.

Deep Learning Models and Formula used:

1) CNN: it's a category of deep learning, feed-forward artificial neural networks wherever connections between nodes do not kind a cycle and use a variation of multilayer perceptrons designed to want tokenize preprocessing. Once CNN on any text knowledge is applied, a pattern is detected at each layer of convolution and therefore the pattern can be N-gram word expression.

2) RNN: this enables to exhibit dynamic temporal behavior for a time sequence [10]. It's conjointly a sequence of neural network blocks that are coupled to every other's sort of a chain.

3) HAN: the general design of the hierarchical Attention Network (HAN) consists of many parts: a word sequence encoder, a word-level attention layer, a sentence encoder, and sentence-level attention layer [11]. It's used to capture 2 basic insights - document hierarchical data structure and completely different informative words during a sentence. Han dynasty has achieved high accuracy and performs higher than CNN and RNN if we've got larger dataset.

Here,P(%) – Positivity percentage; N(%)- Negativity percentage; F() – Frequency of

$$P(\%) = (F(joy) + F(happy)) / Total\ no.\ of\ chat\ sentences(n) \quad \text{Eq. (1)}$$
$$N(\%) = (F(sad) + F(angry) + .. + F(disgust)) / Total\ no.\ of\ chat\ sentences(n) \quad \text{Eq.(2)[5]}$$

According to the algorithmic rule developed, if negativity percentage is below 20 then, it classify as traditional. Next, if negativity proportion is in between 20-40 then, it classify as slightly stressed and if negativity proportion is in between 40- 60 then, it classify as extremely stressed. Further, if negativity percentage is in between 60-75 then, it classify as slightly depressed and eventually, if negativity proportion is higher than seventy five then, it classify as extremely depressed.

The bot is created for providing various treatment suggestions as per level of stress calculated. Below are 3 levels of depression[5]:

• Zero depression- No therapy requirement. The user is completely fine and requires no treatment.

• Slightly stressed- Relaxation required to shed stress. The user is mildly or occasionally stressed. She/he may need irregular breaks to cope up with stress.

• Highly stressed- Reduce stress in life. The user is mildly stressed and requires regular breaks between works to shed the accumulated stress.

• Slightly depressed- Engage in recreational activities. The user is moderately stressed and on the borderline, i.e., he/she may be on the getting highly stressed. Meditation, relaxation is the need of the hour.

• Highly depressed- Engage in recreational activities. The user is highly stressed. Meditation, relaxation is the need of the hours. Possible need to meet doctor.

Algorithm :Mental State Classification(MSC)

Input: A series of user chat ({)
Output: Classification of depressed or stressed
Notation: P E: positive emotion, NE: negative emotion, p_p: positivity percentage, n_p: negativity percentage.
Initialization: P E = 0, NE = 0
while (*T in{*) **do**
e = find emotion (T)

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        if( e = joy k happy )then
                P E = P E + 1
        end
        else
                NE = NE + 1
        end
 end
p_p = find_positivity_percentage(P E)
n_p = find_negativity_percentage(NE)
ifn_p< 20then
        Zero Depression
end
else ifn_p> 20 &n_p< 40then
        Slightly Stressed
end
else ifn_p> 40 &n_p< 60then
        Highly Stressed
end
else ifn_p> 60 &n_p< 75then
        Slightly Depressed
end
else ifn_p> 75then
        Highly Depressed
end
```

For emotional classification, CNN achieved accuracy up to 75% with high consistency for 15 epochs. RNN and HAN have achieved up to 70% accuracy for 15 epochs. However, they're not consistent enough throughout all the datasets.As RNN takes previous input into thought, it takes vast time for the execution as compared to CNN and Han. Hence, it's not desirable, for the huge dataset, in terms of your time complexness. CNN model hasoutperformed the opposite 2 models (RNN and HAN) in terms of training time on the phrase dataset (ISEAR dataset). However, HAN will perform higher than CNN and RNN if we have a tendency to have a large dataset.

Methodology for research in technology gaps :
(i) Bibliometric analysis is a fundamental and powerful method to explore the patterns and future trends of a research topic. Many researchers used this method to explore the research trends in different areas, such as the role of IT innovation [2], project management research [3] and business intelligence and analytics.[4]
The findings are useful in determining the future research agenda. The advent of deep learning technology has created a potential opportunity for chatbot science, as evidenced by publication information and citation reports in literature databases. The study used three tools for bibliometric analysis. They are [4]:
(1) Literature databases - Web of Science (WoS) and ProQuest: to collect publication information and citation report,
(2) Cite Space: to analyze and cluster data, and
(3) Bibliometrix: to determine co-occurrence patterns.

There are also study opportunities in fields other than education, psychology, and linguistics for chatbot and Conversational Agents (CA) applications. The findings of the Cite Space and Bibliometrix studies show that previous research on chatbots and CA is highly fragmented, with a wide area of research potential to explore. Table 1 displays information about publications that are relevant to CA or chatbot .Thereis 583 pieces of scholarly literature on. The majority of them are in the computing fields, whether it's a chatbot or a CA. The most common uses of Education, psychology, and linguistics are all fields where chatbots are used. For better analysis of sentiments of humans by chatbots, this methodology could be used to determine which are the major areas people find any shortcomings in chabots and CAs, which can be areas of research in order to achieve highly intelligent bot.
Table (1). Table for publications information

Field: Research Areas	Record Count	% of 583	Bar Chart
COMPUTER SCIENCE	497	85.249 %	
ENGINEERING	127	21.784 %	
EDUCATION EDUCATIONAL RESEARCH	32	5.489 %	
TELECOMMUNICATIONS	30	5.146 %	
ROBOTICS	21	3.602 %	
PSYCHOLOGY	18	3.087 %	
LINGUISTICS	14	2.401 %	
ACOUSTICS	9	1.544 %	
IMAGING SCIENCE PHOTOGRAPHIC TECHNOLOGY	9	1.544 %	
INFORMATION SCIENCE LIBRARY SCIENCE	9	1.544 %	

(ii) In a survey done with students regarding the usage of chatbot for mental health, 5 statements, 2questions and 1 rating statement was given to record the opinions regarding the same. It was found that –

1. For the statement, "Chatbots are convenient for conversation"; 71.1% students agree to chatbots being convenient for conversation, 21.1% strongly agree whereas 7.9% of them disagree. Figure 1 shows the chart of distribution of student's opinions for convenience for conversation.

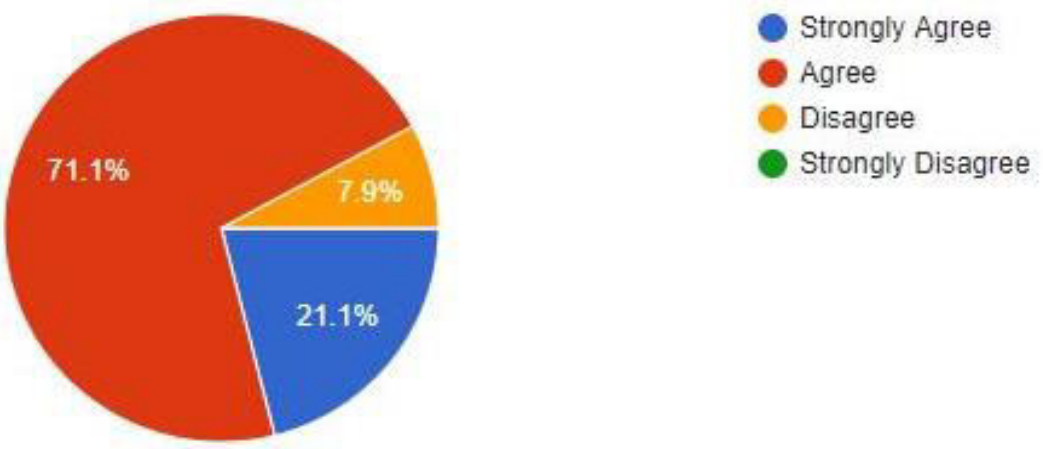

Figure 1 :Pie chart of distribution of student's opinions for convenience for conversation

2. For the statement, "They provide satisfactory service"; 78.9% students agree to chatbots being convenient for conversation, 13.2% strongly agree whereas 7.9% of them disagree. Figure 2 shows the chart of distribution of student's opinions for service satisfaction.

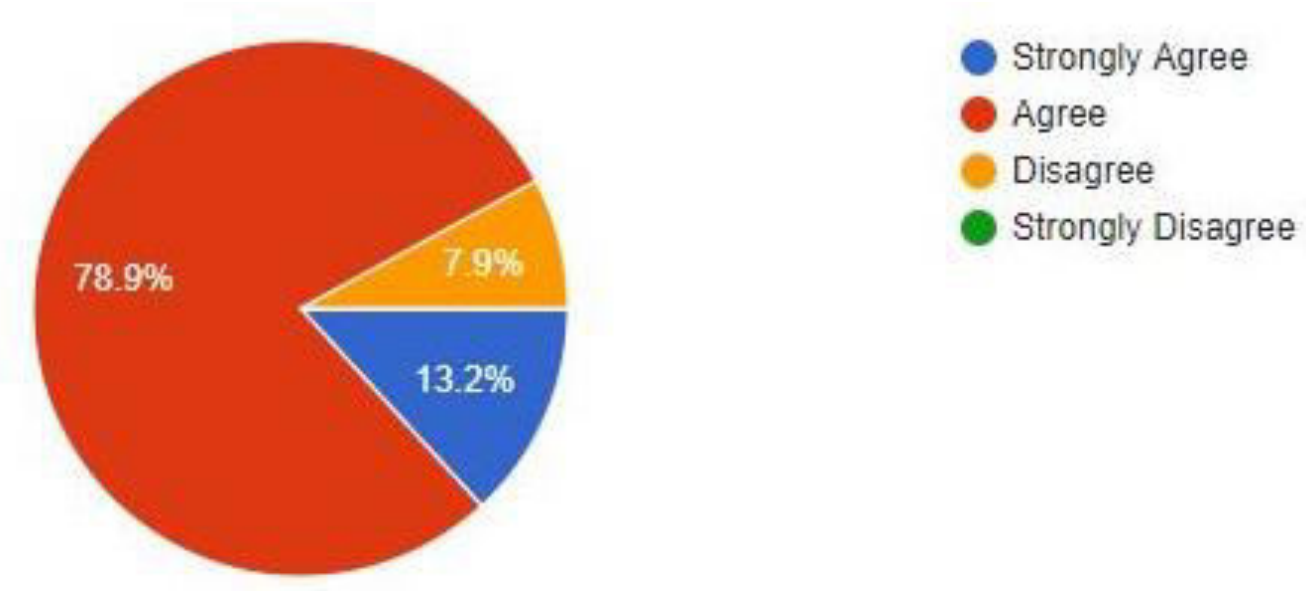

Figure 2 :Pie chart of distribution of student's opinions for service satisfaction.

3. For the question, "Would you use a chatbot to converse in times of stress?" 44.7% students agreed to use chatbots for conversation in times of stress, 28.9% might use whereas 26.3% of them disagreed to use it. Figure 3 shows the chart of distribution of student's opinions if they would converse in times of stress with a bot.

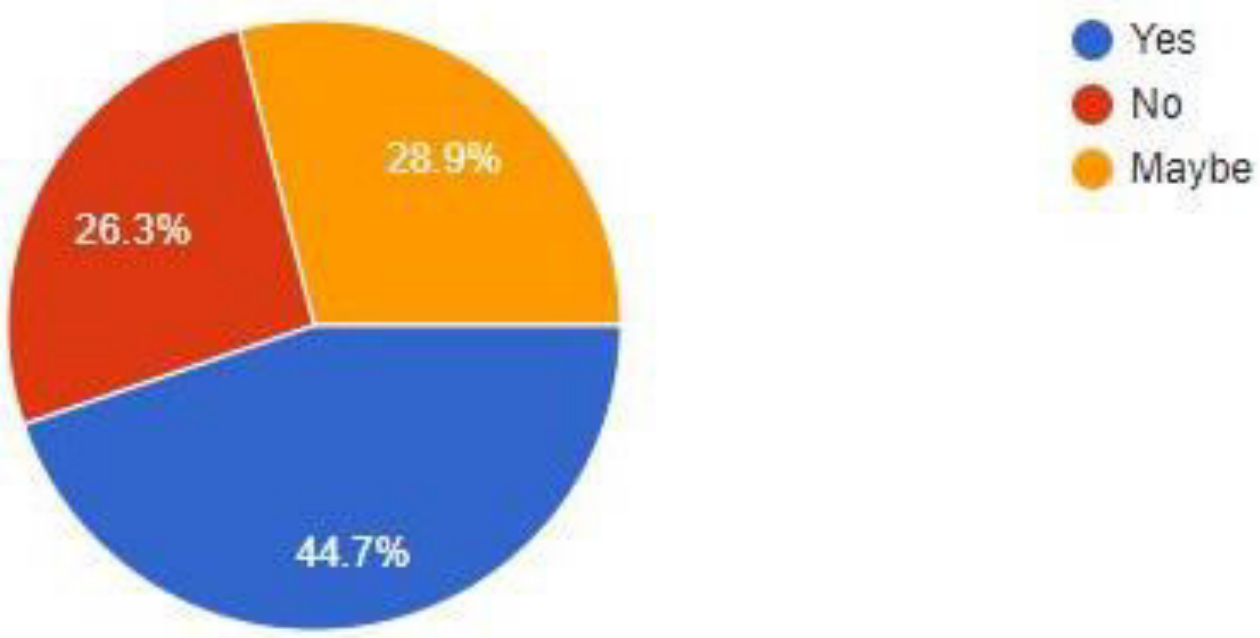

Figure 3.Pie chart of distribution of student's opinions if they would converse in times of stress with a bot.

4. For the statement, "They respond as a human if you share your thoughts" 39.5% students agreed to them responding as a human, 42.1% of their opinion is they might respond as a human and might not at times whereas 18.4% of them disagreed to it. Figure 4 shows the chart of distribution of student's opinions for response of chatbot as a human would.

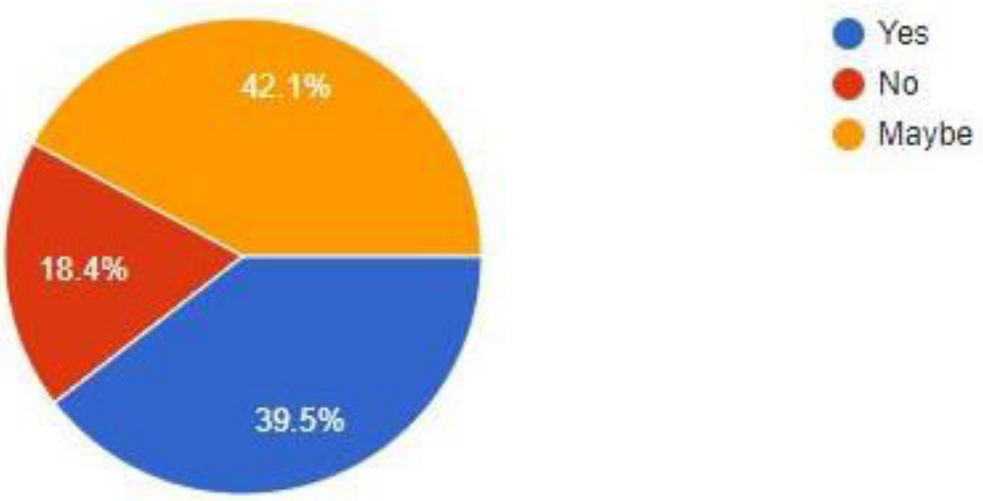

Figure 4 .Pie chart of distribution of student's opinions for response of chatbot as a human would.

5. For the statement, "They are safe and trustable" 65.8% students agreed to it, 21.1% of their opinion is they might be and might not at times whereas 13.2% of them disagreed to it. Figure 5 shows the chart of distribution of
student's opinions for trustworthiness and safety to use chatbots.

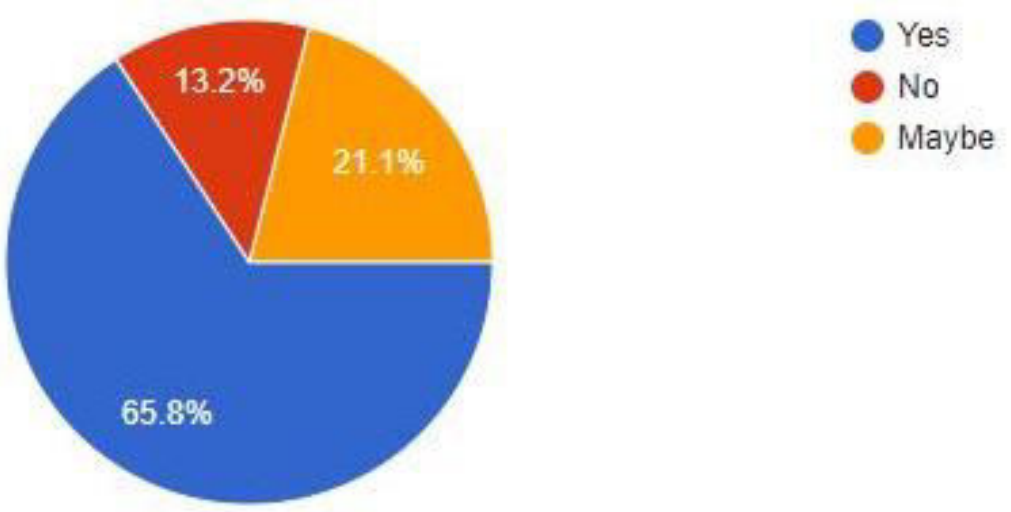

Figure 5 . Pie chart of distribution of student's opinions for trustworthiness and safety to use chatbot.

6. For the statement, "They are helpful in " 37.1% voted for depression, 17.1% for health crisis, 11.4% for anxiety, 5.7% for traumatic events, 5.7% for family changes and challenges, 2.9% for grief and loss, 2.9 % for financial loss, 17.1%% for other issues. Figure 6 shows the chart of distribution of student's opinions.

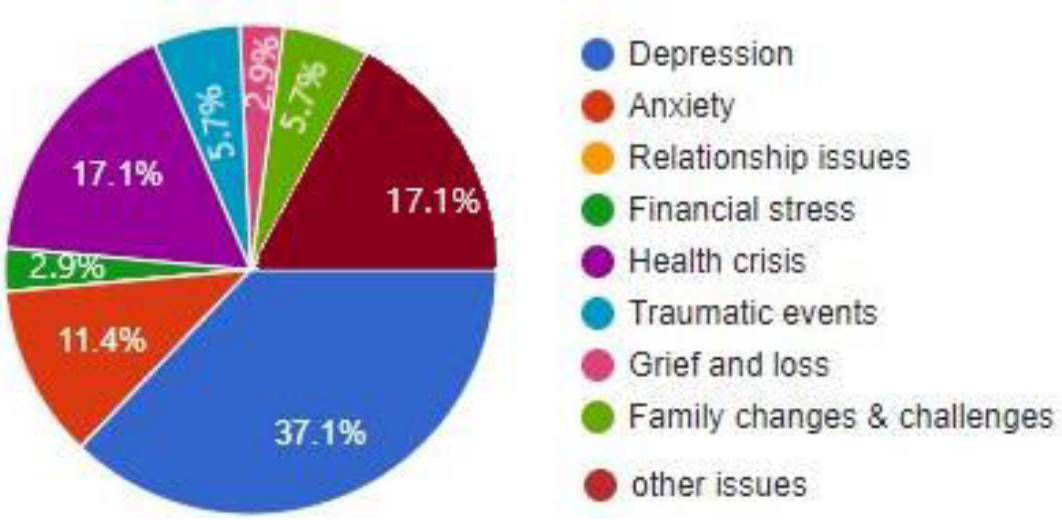

Figure 6 .Pie chart of distribution of student's opinions

7. For the rating statement, "Rate for improvement in mental health services through chatbot " 36.8% rated 3, 34.2% rated 4, 15.8% rated 5, 10.5%rated 2 and 2.6% rated 1. Figure 7 shows the chart of distribution of student's ratings.

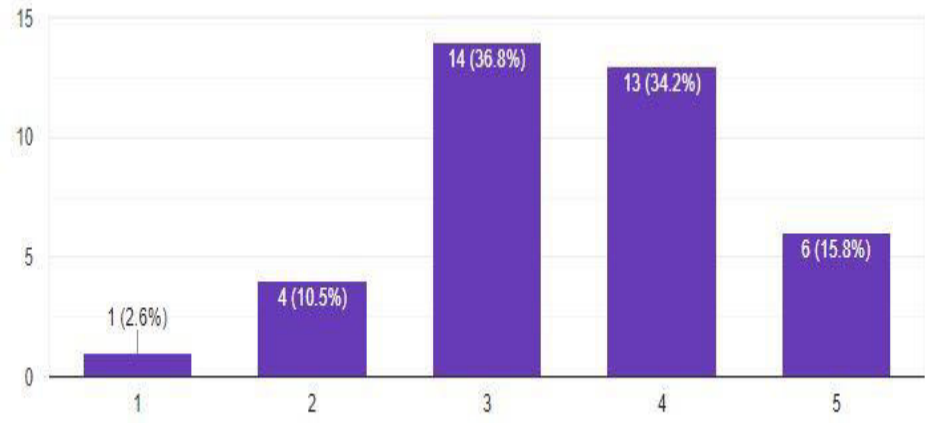

Figure 7 . Bar graph of distribution of student's ratings.

Some student had suggestion for improvement in chatbot. They are –

1. Voice recognition
2. Better decision making skills and sentimental analysis of user
3. Patience and Gratitude
4. Sometimes it doesn't respond us on time. So it would be better if it responds well on time.
5. Due to fixed program chat box can be stuck if an unsaved query is presented in front of them. This can lead to customer's dissatisfaction and result in loss.
6. More options other than a specific answer.
7. Mental state of users detection
8. I think it should have an easy User Interface; the most accurate data should be fed as it is related to health.

Whereas some have responded that they have no idea regarding what should be done for the chatbot so that it could be improvement.

From this survey it can be derived that first of all it should be known to all what a chatbot is and its usage area. They should be motivated to explore it. There are various suggestions regarding shortcomings of the chatbot. These serve as topics for research and implementation for improvement in the technology.

Such methodologies can be adopted to find out the limitations and work on these areas. With improvement this technology will prove to be very promising for the mental healthcare field.

III. CONCLUSION

Utilizing a Chatbot for emotional wellbeing guiding will give various blessings to the user. The current focus of the project is on making parts to convey personalized medical aid recommendations rely on linguistic analysis of the user's input. With the assistance of label of feeling, it also establishes the psychological state of the user like stressed or depressed. The paper suggests a way to treat the minor issues of mental health, ways of identifying gaps and research

topics so that improvement in chatbot can be done. Furthermore, it's to specialize in getting ready a model trained with a lot of adaptation knowledge with an upscale vocabulary. For the NLP module Support Vector Machine, classifier was to categorized users chat knowledge as positive or negative as a result of the most effective machine learning approachto classify text. This will facilitate establishment of a friendly reference to the user in addition as give positive thoughts to user. In the future the team is going to specialize in providing an upgraded version of this application that supports multilanguage in addition as increasing the accuracy of the chat larva to reduce the sensation of artificialness in conversations.

IV. REFERENCES

[1] *B. A. Shawar, and E. Atwell, "Different measurements metrics to evaluate a chatbot system," Proceedings of the Workshop on Bridging the Gap: Academic and Industrial Research in Dialog Technologies, 2007.*

[2] *X. Zhang, H. Chen, W. Wang, and P. Ordóñez de Pablos, "What is the role of IT in innovation? A bibliometric analysis of research development in IT innovation," Behav. Inf. Technol., vol. 35, no. 12, pp. 1130–1143, 2016.*

[3] *J. J. Ng and K. H. Chai, "A Bibliometric Analysis of Project Management Research," 2015 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), Singapore, 2015, pp. 976-980.*

[4] *H. N. Io1 , C. B. Lee1 1, "Chatbots and Conversational Agents: A Bibliometric Analysis", 2017 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM) Department of Accounting and Information Management, University of Macau, China .*

[5] *Falguni Patel, Riya Thakore, Ishita Nandwani, Santosh Kumar Bharti, "Combating Depression in Students using an Intelligent ChatBot: A Cognitive Behavioral Therapy", 2019 IEEE.*

[6] *D. Britz, "Understanding convolutional neural networks for nlp," 2015.*

[7] *J. Wang, Z. Wang, D. Zhang, and J. Yan, "Combining knowledge with deep convolutional neural networks for short text classification.," in IJCAI, pp. 2915–2921, 2017.*

[8] *Z. Yang, D. Yang, C. Dyer, X. He, A. Smola, and E. Hovy, "Hierarchical attention networks for document classification," in Proceedings of the 2016 conference of the North American chapter of the association for computational linguistics: human language technologies, pp. 1480– 1489, 2016.*

[9] *B. Sharma, H. Puri, and D. Rawat, "Digital psychiatry-curbing depression using therapy chatbot and depression analysis," in 2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT), pp. 627–631, IEEE, 2018.*

[10]*J. Jia, "The study of the application of a web-based chatbot system on the teaching of foreign languages," in Society for Information Technology & Teacher Education International Conference, pp. 1201– 1207, Association for the Advancement of Computing in Education (AACE), 2004.*

[11] *K. Chung and R. C. Park, "Chatbot-based heathcare service with a knowledge base for cloud computing," Cluster Computing, pp. 1–13, 2018. [12] M. Dahiya, "A tool of conversation: Chatbot," International Journal of Computer Sciences and Engineering, vol. 5, no. 5, pp. 158–161, 2017.*

[13] *H. Al-Zubaide and A. A. Issa, "Ontbot: Ontology based chatbot," in International Symposium on Innovations in Information and Communications Technology, pp. 7–12, IEEE, 2011.*

[14]*K. K. Fitzpatrick, A. Darcy, and M. Vierhile, "Delivering cognitive behavior therapy to young adults with symptoms of depression and anxiety using a fully automated conversational agent (woebot): a randomized controlled trial," JMIR mental health, vol. 4, no. 2, p. e19, 2017.*

[15] *B. Inkster, S. Sarda, and V. Subramanian, "An empathy-driven, conversational artificial intelligence agent (wysa) for digital mental well-being: real-world data evaluation mixed-methods study," JMIR mHealth and uHealth, vol. 6, no. 11, p. e12106, 2018.*

[16]*P. McGregor, "The best 15 mental health apps," 2018.*

[17] *C. Shu, "Youper, a chatbot that helps users navigate their emotions," 2019.*

[18] *M. Marianne, "10 apps to help with depression in 2019," 2019.*

[19] *T. Kiss and J. Strunk, "Unsupervised multilingual sentence boundary detection," Computational Linguistics, vol. 32, no. 4, pp. 485–525, 2006.*

[20] *V. Sharma, M. Goyal, and D. Malik, "An intelligent behaviour shown by chatbot system," International Journal of New Technology and Research, vol. 3, no. 4, 2017.*