



Depression Detection Using Machine Learning and Artificial Intelligence: A Review

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ABSTRACT: Depression could be a mood disorder that causes a persistent feeling of sadness and loss of interest. It is the foremost leading reason for mental state, which is found to be one in all the explanation for early death[14]. There are many other major causes like suicidal thoughts, isolation, emotional imbalance which directly cause effect on physical and mental state. Many people suffer from depression but they're unaware of it or they are doing not have proper knowledge to handle it. Depression is different from usual mood fluctuations and short-lived emotional responses to challenges in standard of living but, if treated in early stages it will be cured[14]. Especially when long-lasting, and with moderate or severe intensity, depression may become a significant health condition. So analyzing these stages is vital and considering that stage giving proper guidance through a digital solution is the aim of this paper. According to the literature survey we did there are many methods for analysis and detection of depression using different methodology. This paper focus on the different methodologies used to detect depression and concludes with the technique which is useful and overcomes the challenges.

KEYWORDS: Machine Learning, Neural Network, Chatbot, Eye Trajectory, Natural Language Processing

I. INTRODUCTION

Stress is the major problem in our day to day life and if not handled well then it can lead to depression [3]. Depression is one of the major problems in mental illness which may also lead to death or suicide. In a survey it was found that 75% of suicide cases arise as the depression [3]. Also there are different factors due to which people do not prefer to go psychiatrist as they are afraid to share their personal emotions with that person. There is less awareness about depression among people and so they do not give that attention towards it. Many people are unaware that they are suffering from depression and so they are misled. Due to all these factors it is necessary to come up with a digital solution so that people will not hesitate to use it and will also be aware about depression and its causes.

Depending on the number and severity of symptoms, a depressive episode can be categorized as mild, moderate and severe. Or can be given levels as Level 0, Level 1, Level 2, Level 3 and Level 4[3]. These levels are decided according to the symptoms you have. In major or severe depression you may lose interest in daily activities, gain or loss of weight, not getting proper sleep as you do not feel like sleeping, feeling restlessness and slowed down daily activities, being tired and thoughts of attempting suicide. If these feelings are persistent and remain for long time with you then you are having major depression and you should consult a psychiatrist. Whereas in mild and moderate depression people may suffer from any of these symptoms but not for long time[14]. They may get those feelings temporarily for a short period of time.

Machine Learning and Artificial Intelligence are the today's technologies which are helpful for detection of depression. Machine learning is training the machine with the data and then the algorithm predicts for the given input. There are many algorithms like Support Vector Machine, Decision Tree, Ensemble, k- Nearest Neighbor, and Neural Networks which are used for prediction.

II. LITERATURE REVIEW

The literature survey includes some previous papers based on detecting and analyzing depression among people using different techniques like Machine Learning and Artificial Intelligence followed by their conclusions. This review provides detailed survey about the challenges and the different methodologies used to detect depression among people. It also provides the better method which is useful for people and resolves all the challenges.

A. Depression detection from social network data using machine learning techniques[1] :-

1) Description:-

As social networks have been a great platform for the users to communicate with their known people and share their opinions, photos and videos, sentiments reflecting their moods. And this information creates the opportunity to analyze



social network data for analyzing user's mood and attitude when they are communicating via these online tools. Although diagnosis of depression using social networks data has been used intensively but there are some parameters which are not yet studied and detected. In this study, they aim to use Facebook data to perform depression analysis collected from an online public source[6]. Here they propose machine learning technique as an efficient and scalable method to detect depression. The Facebook comments are used to detect different features leading to the depression[4,5]. Machine learning approaches that can use these measures for detection of individuals who are suffering with depression[1].

2) Related Work:-

In this paper[1] study four types of factors are focused on such as emotional process, temporal process, linguistic style and all features together for the depression and processing of depressive data received as Facebook posts. The classification algorithms are used such as decision tree, k-Nearest Neighbor, Support Vector Machine and Ensemble learning.

In the context of Facebook mining, Holleran[7] found an evidence that depression is a major contributor to the overall global diseases. Wang et al. and Shen et al.[8] examined various features related to depression and built multimodal depressive model to detect the depressed users. Although Md. Rafiqul Islam, Muhammad Ashad Kabir, Ashir Ahmed, Abu Raihan M. Kamal, Hua Wang and AnwaarUlhaq have applied SVM, KNN, Decision Tree and Ensemble separately. There are no well known studies that have combined all these machine learning classification algorithms together on same dataset to investigate variations in technique based findings[1].

I. Dataset Exploration:-

They worked on Facebook users comments and captured data using NCapture. As for qualitative analysis Capture is the best tool today[9,10]. It enables to arrange, break down and discover knowledge in unstructured data like open-ended survey responses, social media, interviews, articles and web content.

II. Dataset Preparation:-

After collecting the raw data it was analyzed by using LIWC Software. It is the heart of text analysis strategy and can process line by line[11,12]. The dataset contained total 21 columns consisting of linguistic style information, emotional information, temporal process information and each column gave the individual information about depressive behavior.

III. Building ground truth dataset:-

In this process they construct the dataset. The dataset is divided into two sets (a) for positive (YES) class(depressive comments) and (b) for the negative(No) class(non-depressive comments). Total there were 7145 comments, out of which 58% were "YES" which indicated depression and 42% were "NO" which indicated non-depressive comments.

IV. Feature Extraction:-

Here features are extracted using the psycholinguistic vocabulary package called LIWC which is made by psychological analysts. It is used to understand different emotions of users. It returns different factors with higher level of psycholinguistic features such as psycholinguistic process, linguistic process and other grammar. In this research 23 factors were taken from 70 factors and changed every depressive and non-depressive post to numerical values.

V. Classification models:-

This stage has prediction model for depression recognition through the Facebook comments by considering psycholinguistic features as input. In this work four popular classifiers are used namely Support Vector Machine, Decision Tree, k- Nearest Neighbor, and Ensemble. The analysis was conducted using MATLAB 2016b and the four classifiers were applied. From this study Decision Tree was the best performing model that gave the highest for precision, recall and F-measure.

3) Conclusion:-

In this paper Facebook comments data was used to detect depression using four classifiers called SVM, KNN, Decision Tree, Ensemble and Decision Tree was proved to be the best model amongst the other as it gave highest precision, recall and F-measure[1].



B) DETECTION MODEL OF DEPRESSION BASED ON EYE MOVEMENT TRAJECTORY[2]

1) Description:-

Depression is the common disease among many mental illnesses. At present the analysis or detection of depression is only available on the basis of text or narrated description by the patient. Based on the characteristic of eye movement trajectory this paper proposes a new depression model by using artificial neural network. With the help of this model doctors can get better help to diagnose the patient. In this paper Yifang Yuan and Qingxiang Wang analyze the characteristics of eye movement trajectory in the eye-tracking data and design depression detection model that can assist doctors in diagnosing the disease[2].

2) Related Work:-

I. Data preprocessing:-

Eye tracking data of depressed patients between 18-60 age and normal people's data was collected. The data collected was screen-record data obtained using iView X Red 500 eye tracker[2]. It contains a group of 74 depressed people and 75 normal people. The people in this dataset were told to focus on an object and not to distract to left or right side of the object. For each trial there was (1*1) wide white crosses presented for the 05 duration at random interval of time. It has the eye tracking data in .csv file format with time series features. Each sample contained 500 rows of data containing information of time, distracted coordinates, eye coordinates, etc. In this paper they selected 10 rows of each sample of distracted data.

II. Data Conversion:-

The eye tracking dataset contained 149 matrices. Convert the 3-D array into 2-d array[2].

III. Feature Extraction and transformation:-

Feature transform is used to obtain the distance between the eye coordinates and distracted coordinates from the sample. Depression is detected by analyzing the distance between the eye coordinates and the distracted coordinates in the sample and the movement of the eye trajectory coordinates.

Now artificial neural network is used using Python-based Keras.

Following are the steps[2]:-

- i. A single fully connected hidden layer is created with 30 neurons as input variables. The weights are initialized using Gaussian random number. The rectifier activation function is used.
- ii. Now set the output layer of neurons and sigmoid function in order to produce a probability output in the range of 0 to 1.
- iii. Use the loss function during training which solves the binary classification problem.
- iv. Use the Adam optimization algorithm for gradient descent

3) Conclusion:-

After the network is built the model is trained, tested, evaluated and optimization is done. The model gives the prediction accuracy of 82.55% [2].

C) DIGITAL PSYCHIATRY-CURBING DEPRESSION USING THERAPY CHATBOT AND DEPRESSION ANALYSIS[3]

1) Description:-

The objective of this paper is to use cognitive behavioral therapy or therapy Chatbot to analyze the level of depression in particular individual. With the increasing stress in day to day life people are more prone to depression and its consequences are very disastrous. So it is the need to help people against depression using technology. In this paper they talk about the system which not only detects the levels of depression but also gives some remedies according to the level of depression. This study uses Python as the programming language which can be integrated with the android application so that people can get the messaging platform. The concept is to build a platform which is user friendly and emulates like a psychotherapist. This research is an attempt to help people with the depression with the help of virtual therapist using Chatbot. Here the concept of chatbot is used to provide the users free environment to chat with the virtual bot like a friend and then the work of bot is to analyze the levels of depression and according to the level suggest some temporary remedies to the user. This can be named as therapy chatbot like the ones which are available like Apple (Siri), Microsoft(Cortana), Google (Assistant), Amazon(Alexa) which recognizes voice and gives you the answers. But this study also did not intend to suggest that a bot is replacement to the skilled psychiatrist[3].

2) Related Work:-

I. Factors Encouraging The Use Of Online Therapy:-

- i. Increase in self-disclosure helps people to reduce the level of depression in an individual. The more a person interacts with others the lesser is the chance of the person to get into depression. So with the



help of therapy chatbot the person will not feel any risk of sharing his/her personal feelings with the bot[13].

- ii. People is depression tend to go in extreme isolation with everything like social media. And that is not so good for that individual as it increases the problem of distancing with your own people and maintaining relationship becomes difficult.
 - iii. 24/7 there is facility of communication as chatbot can help the individual anytime they need.
 - iv. This increases engagement in the activities and one will not feel irritated and shift focus on other relevant things. All such factors have encouraged to use digital psychiatry with the help of virtual assistant.
- II. Methodology For Building A Therapy Chatbot:-
Chatbot can automate the process of curing fundamental problems like depression.
It can be built using below methodology:-
- i. Using Machine Learning
 - ii. Using text based cognitive behavioral approach (Natural Language Processing)
- III. Logical Formulation:-
Carry out the questionnaire having different questions related to personal information of that individual like How was your day? Or How you are feeling today? and then at the real time according to the text as input from user, analysis of text is done and it predicts the level of depression from the text it gets.
- i. There are following levels of depression[3] :-
Level 0 : Zero depression, completely healthy
Level 1: Slightly stressed
Level 2: Highly stress
Level 3: Slightly depressed
Level 4: Highly depressed
 - ii. There are following levels of therapy according to the levels of depression[3]:-
Level 0: No therapy required.
Level 1: Relaxation is required to avoid stress as the user is mildly or occasionally stressed and requires break.
Level 2: Reduce stress in life and avoid the stressful situations with regular breaks in between from your daily routine.
Level 3: Get engaged in recreational activities or interested activities to moderate the stress. Meditation, relaxation and breaks are required when ever is the need.
Level 4: Immediate help required. Contact a psychiatrist and take regular therapies from them. If avoided it can lead to getting suicidal thought.
- 3) Conclusion[3]:-
Here in this study the use of therapy chatbot is implemented for detecting the level of depression and giving suggestions according to the level. They talk about different factors which are overcome by the use of Chatbot for analyzing and recommending some temporary solutions to the individual. But there are also some challenges like the slight mood difference does not need a therapy. And the therapy bot requires much more improvement in terms of user satisfaction.

III. CONCLUSION

There are many ways to detect depression as discussed in the literature review. But there are some challenges like availability of real time data, analyzing real time data, providing temporary solution after analysis to the patient, personalized solution. So after the review we got that the Digital Psychiatry can overcome these challenges and can help people in some way by providing them with temporary solution after the analysis or detection of depression. In future work taking the same concept we can also give personalized help to people and as it will be like an application we can help spreading awareness regarding depression among people.

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