

Review on Depression Prediction using Different Methods

Mrunal Kulkarni¹, Prof. Arti R.Wadhekar²

¹M.Tech. Student (Department of Electronics And Telecommunication Engineering, Deogiri Institute of Engineering and Management Studies, Aurangabad, Maharashtra, India)

²Assistant Professor (Department of Electronics And Telecommunication Engineering, Deogiri Institute of Engineering and Management Studies, Aurangabad, Maharashtra, India)

Abstract - This Paper is focused on the basic survey of the methods which are used to predict depression in humans. Depression is a mental disorder which may lead to suicide if not cured at early curable stages. So it is very important to predict depression as soon as possible. Many people in the world are suffering from depression in their day to day life. Depression is of different types and can be predicted by different ways. In this paper, study about all the techniques which are used to predict depression and their relative study about techniques, methods, algorithms used to predict depression is done.

Key Words: BECK's Inventory, Artificial Intelligence, EEG, Voice Recognition, Sentiment Analysis, ANN, Python, MATLAB.

1. INTRODUCTION

Depression is a very serious disorder and it is very necessary to predict it at very early curable stage. Human Brain is a most complex part of the body. So it is very difficult to understand its complexity. Depression is found as a Mental disorder, so to predict depression is a very complex part. Psychiatrist says that diagnosis and cure of Depression is done mostly by using Questions and Answers and by applying various Psychometric tests and theory and by observing patient's response to it. But Now a days, research says that there are also other methods using which we can predict depression. This methods are Depression Prediction using EEG signal Processing, Depression Prediction using Audio and Visual Analysis, Depression Prediction using Text analysis which includes sentiment analysis, emoji analysis, etc. This methods mostly belongs to Artificial Intelligence, Machine learning algorithms in it. Following are some key points which everyone should know before learning these Depression prediction methods.

1.1 Artificial Intelligence (AI)

Artificial Intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and react like humans .A machine with the ability to perform cognitive functions such as perceiving, learning, reasoning and solve problems are deemed to hold an Artificial Intelligence (AI). AI represents simulated intelligence in machines .It is a subset of Data Science. Artificial Intelligence exists when a machine has a cognitive ability .The AI includes human level concerning reasoning, speech and vision.AI is used to avoid repetitive task. AI can

repeat a task continuously.AI is used in all industries, from marketing to supply chain, finance, food product, social media applications, etc.

1.2 Machine Learning(ML)

Machine Learning (ML) is a data analytics technique that teaches computers to do what comes naturally to humans and animals, i.e., learn from experience. ML algorithms use computational methods to 'learn' information directly from data without relying on a predetermined equation as a model. The algorithms adaptively improve their performance as the number of samples available for learning increases. ML is used when:

- Hand written rules and equations are too complex as in face recognition and speech recognition.
- The rules of a task are constantly changing as in fraud detection from transaction records.
- The nature of data keep changing and program needs to adapt as in automated trading ,energy demand forecasting and predicting shopping trends.

1.3 Deep Learning

Deep Learning imitates the way our brain works, i.e., learn from experiences. It uses concepts of neural networks to solve complex problems. Deep learning works as follows:

- Deep Learning is based on basic unit of brain called brain cell or a neuron. Inspired from a neuron, an artificial neuron or perceptron was developed.
- A biological neuron has dendrites which are used to receive inputs.
- Similarly, a perceptron receive multiple inputs, applies various transformations and functions and provides an output.
- Just like how our brain contains multiple connected neurons called neural network, we can also have a network of artificial neurons called perceptrons to form a deep neural network.
- An Artificial Neuron or a Perceptron models a neuron which has a set of inputs, each of which is assigned some specific weight. The neuron then

computes some function on these weighted inputs and gives output.

1.4 Artificial Neural Network (ANN)

An Artificial Neural Network (ANN) is a computational model based on the structure and functions of biological neural networks. ANN is an information processing model that is inspired by the way biological nervous systems such as brain process information. Information that flows through the network affects the structure of ANN because a neural network changes or learns, in a sense-based on that input and output. ANNs are considered nonlinear statistical data modelling tools where the complex relationships between inputs and outputs are modelled or patterns are found.

Advantages of ANN are:

- Actually Learn from observing data sets.
- ANN used as a random function approximation tool.
- ANN takes data samples rather than entire data sets to arrive at solutions, which saves both time and money.

1.5 Electroencephalography

Electroencephalography is a medical imaging technique that reads scalp electrical activity generated by brain structures. The electroencephalogram (EEG) is defined as electrical activity of an alternating type recorded from the scalp surface after being picked up by metal electrodes and conductive media [1]. The EEG measured directly from the cortical surface is called electrocardiogram while when using depth probes it is called electrogram. EEG measured from the head surface is considered. Thus electroencephalographic reading is a completely non-invasive procedure that can be applied repeatedly to patients, normal adults, and children with virtually no risk or limitation.

2. LITERATURE SURVEY

In this paper, various techniques for measuring depression were studied. The depression can be predicted by using Question and Answer (Q & A) Analysis, i.e. psychometric test, using EEG signal processing, using Audio, visual and text analysis, using Sentiment analysis, etc. The in detailed survey of these techniques is as below:

Question and Answer (Q & A) Analysis or psychometric test using questions are generally referred by psychiatrists. There are some standard questionnaires used by doctors to determine the levels of anxiety and depression that a person is experiencing. One of the most commonly used test is Hospital Anxiety and Depression Scale (HADS). The HADS is a fourteen item scale that generates ordinal data. Seven of the items relate to anxiety and seven relate to depression. The item on the questionnaire consists of questions like 'I feel tense or wound up', 'worrying thoughts go through my mind', 'I have lost interests in my appearance', etc. Each item on

questionnaire is scored from 0-3 and this means that a person can score between 0 and 21 for either anxiety or depression [2]. The other most commonly used test by psychiatrist is BECK's Depression Inventory (BDI). This test is used for measuring the severity of depression. In its current version BDI -II is designed for individuals aged 13 and over, and is composed of items relating to symptoms of depression such as hopelessness and irritability, cognitions such as guilt or feelings of being punished, as well as physical symptoms such as fatigue, weight loss, and lack of interest in sex.

Another technique to predict depression is by analyzing EEG signal, i.e. using EEG signal processing. Mallikarjun H. M. and Dr. H. N. Suresh in their paper, "Depression Level Prediction using EEG signal processing"[1], obtained Electroencephalogram Gram (EEG) signals from publicly available database and are processed in MATLAB. It is useful in classifying subjects with the disorders using classifier tools present in it. For classification purpose, the features are extracted from frequency bands (alpha, delta and theta). Initially EEG signals were read using EDF browser software and the signals were loaded into MATLAB to get log Power Spectral Density from EEG bands. The results obtained from MATLAB are fed into neural network pattern recognition tool and ANFIS tool box which is integrated in MATLAB. These are powerful tool are used for data classification. Relevant extracted features parameters such as mean, standard deviation, entropy are used as inputs to the ANFIS and nprtool.

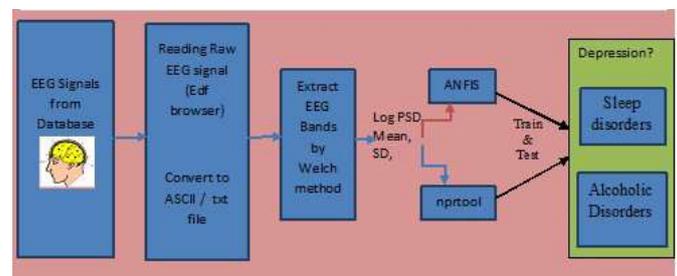


Fig -1: EEG signal processing for classification of disorders

The depression can be predicted by using Text, Audio and Visual Analysis of the person. Though it is very complex method and uses various machine learning algorithms, the research on these methods are proven by researcher and engineers to predict persons mental state, i.e. it can be used to predict whether the person is depressed or not using various parameters. Behaviour of a depressed person shows change in his speaking tone and features (may be very low voice or very loud), his facial expressions and head movement when compared to a non-depressed person. Shubham Dham and two others in their paper "Depression Scale recognition using Audio, Visual and Text Analysis"[3], introduced depression recognition through visual, audio and text features using machine learning algorithms like SVM and neural networks for classification of dataset. GMM clustering and fisher vectors were calculated on the relative distance of the facial regions. Facial Regions used in recording the relative distance of certain points involves facial expressions like smiling, laughing, and other visible

emotions. Head pose, statistical descriptors on gaze, pose and blinking rate were also calculated. Verbal responses of the person coded in the form of text (sentences, words, negative words) and audio (low level) features hold the information regarding the behaviour of the person. The features extracted from that were trained on SVM machine learning classifier. Results from audio, fisher vectors and text features, both individually and combined outperformed the baseline results on validation dataset. Fisher vector features were also classified using Neural Networks.

Different Machine Learning Techniques and Algorithms [5]: There are different machine learning techniques and algorithms which are depending on the type of data used for classification. Some machine learning techniques are supervised learning, unsupervised machine learning, semi-supervised learning, reinforcement learning. Supervised learning concerned with classified data, i.e. data with label, while unsupervised learning unlabeled data. Semi-supervised learning techniques concerned with both labeled and unlabeled data. Reinforcement learning doesn't require any data to predict output.

Based on these techniques there are algorithms used for classification and training purpose. Examples of Supervised learning algorithms are decision trees, rule-based classifiers, naïve bayesian classification, k-nearest neighbors classifiers, neural network, support vector machine. Some of the unsupervised learning algorithms are k-means clustering, hidden markov model, Gaussian mixture model.

- Naïve Bayesian: To calculate the probability that an event will occur, given that another event has already occurred, Bayes Theorem is used. To calculate the probability of hypothesis(h) being true, given our prior knowledge(d), we use Bayes's Theorem as follows:

$$P(h/d) = (P(d|h) P(h)) / P(d)$$

where: P(h|d) = Posterior probability. The probability of hypothesis h being true, given the data d, where $P(h|d) = P(d_1|h) P(d_2|h) \dots P(d_n|h)$ P(d)

P(d|h) = Likelihood. The probability of data d given that the hypothesis h was true.

P(h) = Class prior probability. The probability of hypothesis h being true (irrespective of the data)

P(d) = Predictor prior probability. Probability of the data (irrespective of the hypothesis) .

This algorithm is called 'naive' because it assumes that all the variables are independent of each other, which is a naive assumption to make in real-world examples.

- Support Vector Machines (SVM): SVM is binary classification algorithm. Given a set of points of 2 types in N dimensional place, SVM generates a (N-1) dimensional hyperplane to separate those points into 2 groups. Say you have some points of 2 types in a paper which are linearly separable. SVM will find a straight line which separates those points into 2 types and situated as far as possible from all those points.

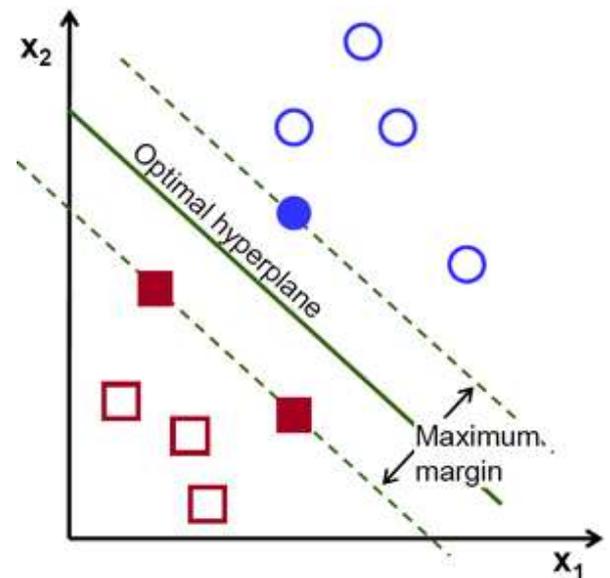


Fig-2: SVM Algorithm

3. PROPOSED SYSTEM

From above survey, different techniques to predict depression are studied. Here we are proposing a system to predict depression by taking reference of above survey. One website is to be developed using python language which consist of some of above techniques to measure depression. On primary basis, Q & A analysis using BECK's depression inventory and EEG signal processing, will be added on the website. The main aim to develop such website is that anyone can measure depression including doctors at any time. First part Q & A analysis can be accessed by any user to check whether he or she is in depression or not, by giving answers to the BECK's depression inventory .From the total score the user can predict the level of depression. If the level of depression is high, user can concern to the doctor. Also the second part, i.e. depression prediction using EEG signal processing can be used by doctors or psychiatrists. In this only they have to take EEG signals of the patient by using Neurosky's mindwave kit and give it to the system. The sytem uses preprocessing techniques like finding alpha, beta, theta, delta brain waves and finding parameters like psd, log psd, mean ,median, entropy from that brain waves and finally all these parameters are given to the classifier machine algorithm such as Support Vector Machine (SVM) for training purpose. After training, the system automatically

detect whether the person is depressed or not, when the EEG data of that person is given for testing. All these programming is done by using Python as it is the best language for Machine learning and it has more libraries than MATLAB. Unlike MATLAB, python is free and easily portable on any operating system.

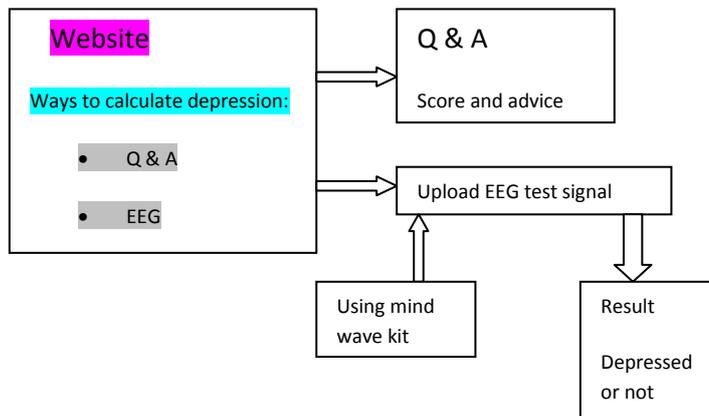


Fig -3: Proposed System

4. CONCLUSION

In this paper, different ways to predict depression have learned. Among those methods psychometric test(Q & A) method and EEG signal processing methods can be used easily and accuracy of these methods is higher as compared to audio and visual analysis. Audio and Visual Analysis for depression prediction is also a great research but it is very complex method and cannot operate easily in real time. So in this paper, First two method, i.e. psychometric test and EEG signal processing are proposed to predict depression by using machine learning algorithms as a classifiers.

REFERENCES

- [1] Mallikarjun H. M. and Dr. H. N. Suresh , “Depression Level Prediction using EEG signal processing”, International conference on contemporary computing and informatics (2014).
- [2] Barry A. Edelstein and others, “Assessment of Depression and Bereavement in older Adults”, in handbook of assessments in clinical gerontology (second edition),2010.
- [3] Shubham Dham and others, “Depression Scale recognition using Audio, Visual and Text Analysis”, www.researchgate.net, September 2017.
- [4] H.M. Mallikarjun and P.Manimegalai , “Adaptive Neuro-Fuzzy Inference System for Farmers Depression Stage Prediction”,International Journal of Pure and Applied Mathematics, volume 116 ,no. 24 , 2017.
- [5] Mohssen Mohammed and others, “Machine Learning Algorithms and Applications”, International Standard Book Number-13: 978-1-4987-0538-7 (Hardback) © 2017 by Taylor and Francies group.