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Depression Prediction Analysis using Deep Learning: A Survey

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ABSTRACT

Depression is the leading cause of disability for people. It badly affects on physical health of people. Now a day it is observed from children having more than twelve edge to onwards. Machine learning helps doctors predict who might be at risk for a particular disorder. Machine learning, including pre-treatment symptom scores and electroencephalographic characteristics, predicts whether depressive symptoms will improve with antidepressants, and that means they can help them improve. This paper proposes the deep literature review of depression analysis based on offline and online sources using advanced technology. The research work divided into three parts, The First part focuses on the problem definition and second contains deep literature review based on online and offline resource and third part contains the proposed plan of work.

KEY WORDS: DEPRESSION ANALYSIS, DEPRESSION PREDICTION, MENTAL ILLNESS HEALTH DISORDERS, DEEP LEARNING, BDI (BECK DEPRESSION INVENTORY).

INTRODUCTION

Now a day with an advanced technology, Neuroscientists and clinicians around the world uses machine learning to develop treatment plans for patients and identify key markers of mental illness before they begin. Researchers have combined data from supercomputers to identify patterns in neuron imaging data that can help predict the onset and severity of depression, anxiety and other mental disorders in patients. The machine-learning model can be trained to predict what type of depression a patient is likely to experience, how severe the depression will be, and how long it will last over a period of time. This is based on providing input functions for machine learning models, such as age, gender, race, ethnicity, age group, education level, health status and other factors.

Mental illness is a great cause behind degrading health condition which changes a person's disturbed mind condition, psychological changes emotions, or physical behavior [Chang Su, 2001][Jan, Asim, et al., 2018]. Data science and machine learning provides great tool to help existing doctors, psychiatrists and therapists support their patients. Machine learning provides psychiatrists and mental health professionals with the opportunity to identify different types of disorders and develop a better understanding of their symptoms. They could help identify important behavioral biomarkers that help mentally ill people decide which patients are most likely to develop a particular mental disorder [Zhou, Xiuzhuang, et al, 2018]. Depression is typically identified based on its types Major Depressive Disorder, Persistent Depressive Disorder, Seasonal Affective Disorder, Premenstrual Dysphonic Disorder, Postpartum Depressive Disorder,

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Depressive Disorder Due to Another Medical Condition and Other Specified Depressive Disorder e.g. Bipolar Disorder.

Related Work: Before performing literature review it is categorize based on relevant articles of four groups. First is literature survey based on articles and publications second is literature survey based on data sets and third is literature survey based on real world data which was obtain by taking interviews of doctors, psychologists and psychiatrists. Video and Voice recordings of patients were used to extract paralinguistic features that were used to predict depression. The scientists analyzed the activity of the entire brain using machine learning, observing only those neural regions that are said to be relevant for predicting antidepressant benefits. Another review performed is based on case studies, diagnosis and prognosis based on the clinical data of various patients, Deep analysis of genetics and genomics data taken for consideration for understanding mental health conditions of various patients, Video and voice expression related data analysis for disease detection. Finally, we discuss challenges in using machine learning algorithms to improve our understanding of mental health conditions and suggest several promising directions for their applications in analysis of depression analysis.

A. Literature survey based on articles and papers: Some biomarkers decided and are recorded in the Lifelines database, so they can be described as cases of mental illness or healthy cases of machine learning prediction. Moreover, it is well known in the machine learning community that publicly available data sets have the potential to promote research on a particular subject, such as predicting depression through language use. Researchers perform literature review on mental health outcome. Mental illnesses are a basic problem behind an individual's physical health. Several Artificial Intelligent methods used in traditional as well as recent researches for studying the mental health state of patients. For diagnosis patients mental health condition psychiatrists and psychologists uses several software tools for decision-making based on patients' historical data.

Patient's historical data contains his or her medical records, their behavioral data, social media usage, etc. Researchers in their paper perform review on existing research on various applications of Deep Learning algorithms in mental health outcome research [Chang Su, 2001]. Researcher proposed Artificial Intelligent approach to monitor depression. This AI based approach is responsible to predict the depression from vocal and visual expression. The speech audio is extracted from video data where short segments are produced. MFCC's are extracted using regression technique to predict depression scale. FDHH is proposing to capture temporal movement on the feature space. FDHH plus Audio features were fused using regression techniques for predicting BDI Scales. CNN is used to extract deep features from image along with hand crafted features (EOH, LPQ, LBP etc.) and for joint tuning PLS and Linear regression were combined [Jan, Asim, et al., 2018].

Researchers in their paper describes about algorithms for facial feature extractions from visual system. A visual feature extraction system covers CNN, DCNN, LDA and neural Network. Researcher specifies ranking of algorithms by performing comparative analysis, where some data sources also explained [Pampouchidou, 2019]. Researcher focuses on development of mental health monitoring mechanism which uses mobile base for collection of data and Machine learning methods. It collects data from the sensors and predicts information like mood, physical activity and location. Automatic continuous monitoring takes place of different condition involving stressful condition, severe anxiety and depression. Researcher focused on mental disorder conditions.

Researcher does not include an exhaustive review [Enrique Garcia-Ceja, 2018]. Researcher describes that facial appearance plays an important role in depression analysis and could be responsible of indicating depressive disorder. Deep regression network is used to learn depression representation having visual expression. In this paper CNN equipped with a global avg. pooling layer having facial data depression is trained first. This data is responsible for identifying point of input images. DepressNet is used with multiple models of different face areas like foreheads, eyes and lips were combined to develop and improve the overall performance. DAM induced by their learned deep model may help disclose the visual depression pattern on faces and understand the insights of automated depression diagnosis. The fusion obtained of Facial appearance & dynamics outperformed MAE is 7.47 and RMSE is 9.55 [Zhou, Xiuzhuang, et al, 2018].

In another paper researcher works on mental health disorder by concluding that it not only affects emotional level but also degrades physical as well as psychological mind state of person. The daily routine of him is lack of enthusiasm He experiences lonely and lack of interest and sad life. They proposes multimodal feature. It employs joint tuning layer for fusing the features using SVM & Neural network (AVEC 2017). Facial Action Coding System FACS) for capturing emotions, Action units, Gaze and pose. The result obtained were crossed the baseline by 17% on audio features & 24.5% on video features. RMSE=5.535 & MAE=4.737 [Dham, Shubham, 2017]. Researcher declared about the Traditional developed clinical diagnosis methods that they are subjective, complex, complicated and they need extensive involvement of an experts. Methodology proposes in researcher works uses fusion of frames. Convolution Neural Network (CNN) is operating on multichannel behavioral signals.

The result of depression severity is predicted based on regression. Spectral features & hand crafted features containing Action units and gaze directions which are extracted & fused using CNN. Binary classification is done for depression prediction & regression for depression severity both methods improved significantly compared to previous state of art [Song Siyang, 2018].

Researchers find out the limitations in the recording technology for the measurement of EEG activity in experimental and clinical applications. One of the main advantages of machine learning is that the algorithm can be improved by using data sets with different data types such as brain scans, brain waves, EEG data and other data. EEG signals with dry electrodes on forehead provide wide-ranging information related to variety of cognitive dysfunctions and disorders. Researcher includes advanced sensing technology and advanced signal processing algorithms for supporting people with their health related needs such as sleep monitoring, headaches prediction and depression treatment.

Different type of sleep pattern and headache level also considered while treating depressed person. Electrodes on foreheads were responsible to measure and monitored the parameters with the help of which depression can be calculated. Each of processed data is transform in to thirteen dimensional feature vector used to construct relevance vector machine for sleep stage classification using SVM & RVM. Disadvantage of this approach is it is not able to fuse the brain wave. Machine learning models can be trained on the basis of clinical trial data based on actual depression diagnoses, and can be further developed on the basis of previous predictions, in which the model confirms or corrects the actual diagnosis of previously monitored patients [Arjun P Athreya, 2019]. Another researcher focuses on detection of depression using audio and visual recordings. Some time some people experiencing depression also behaves normally without showing their stress and sorrows. Acoustic features were extracted from to detect clinical depression in Childs and adults both when acting normally & when asked to reveal their gloominess. With classifier trained on only non-conceal behavior which has given 81% accuracy & 75% sensitivity when tested on concealed data [Ashley E. Tate, 2020].

Machine learning could help predict a person's characteristics of depression, just as it predicts the occurrence and severity of other mental disorders, such as anxiety and depression. The research implemented three different machines - learning algorithms: an unsupervised algorithm that combined hierarchical clusters to create medical symptom clusters; a supervised algorithm to identify and describe key clusters with significant depression relationships; and an unsupervised approach. By using machine learning to evaluate the clinical data, the researchers were able to create a series of 3D models of depression and anxiety, as well as a three-dimensional model of suicide risk, in which they could distinguish between people who attempted suicide and those who did not, based on the patients "priority clinical data. Researchers modeled the visible and vocal cues for despair evaluation. Motion records histogram (MHH) is used to seize dynamics throughout the visible information, that's then fused with audio capabilities. PLS regression makes use of those capabilities to expect the scales of despair. Researchers had followed number of modalities, which is used to expect to have an effect on and despair reputation.

They fused collectively numerous capabilities which include neighbourhood binary pattern (LBP) and head movement from the visible modality, spectral shape, and mel-frequency cepstral coefficients (MFCCs) from the audio modality and producing lexicon from the linguistics modality. They additionally protected the baseline capabilities neighbourhood Gabor binary pattern three orthogonal planes (LGBP-TOP) furnished via way of means of the hosts. They then follow a selective function extraction technique and educate a guide vector regression system to expect the despair scales.

B. Literature survey based on data sets available: The machine learning model can be trained to identify relevant brain waves that occur before the onset of depression. For example, it can correlate brain waves identified in a particular brain system with patterns that are more likely to lead to symptoms such as anxiety, depression, anxiety disorder, or other mental disorders. They can also correlate with a pattern that is more consistent with the brain's response to stress or anxiety than with other brain systems. For example, the machine learning model can be configured to provide a risk coefficient that indicates the likelihood that a patient will develop depression for any type of depression that the patient has experienced over a period of time. The biomarkers, which are published in the Lifelines database, can identify mental illness and healthy cases for machine-learning predictions. These biomarkers are reported based on the first brain wave signal, which provides an input function for the machine learning models.

Because the Deep Learning System can use data from the self-recorded depression section of the Lifeline database on a case-by-case basis to predict which patients are at high risk of suicide from clinical notes, doctors can refer high-risk patients for treatment. Cases in the Lifelines database that do not report "self-reported depression," but use the biomarker as a predictor of whether or not patients will experience some or all of these types of depression for some time[Al Jazaery, 2018] [Arjun P Athreya, 2019].Machine learning can be applied to a curated large dataset that contains self-reported depressives, as described here. Machine learning has been applied in the form of a supervised machine learning model, configured to adapt to the patient's actual diagnosis of depression. The machine learning model was trained using the EMA Actigraph data and other data sources such as brain scans, brain currents and EEG data. In implementation, the machine learning model is configured as it is and can refine its ability to predict brain systems associated with brain waves. For this study, visual, acoustic and other data were used to classify patients with depression and their treatment [Al Jazaery, 2018].

Prediction of antidepressant response can be improved by combining clinical assessments of the severity of depression routinely used in clinical practice with machine learning and novel pharmacogenomic biomarkers. SNPs and the total score of depression trained on the machine learning methods used can predict remission and response

in the remaining two sets of data. Pharmacogenomic, coupled with machine learning, also be used to discover new pharmacogenic targets in existing data that can be used to predict antidepressant responses These new pharmogenomics biomarkers will in turn improve the functioning of the machine learning system, thereby improving the ability of machine learning algorithms to use data from the Lifelines database and other datasets to predict antidepressant responses in patients at high risk of suicide [Radha Krishna Rambola, 2017]. Researchers study provides evidence for the use of machine learning to classify depression groups based on EMA actigraph data. It seems promising to develop a more accurate and accurate prediction system for the diagnosis and treatment of depression in patients by using ema sensor data and to further explore the application of this technology to the treatment of depression.

Given the mathematical challenges under discussion, it is not surprising that the use of machine learning to predict the outcome of antidepressant treatment has attracted considerable interest in recent years. As the data sets grow in size and the number of patients increases, it becomes increasingly difficult to properly unbundle the variables associated with patient outcomes, and as a result, the data complexity increases with the size of the data set [Radha Krishna Rambola, 2017]

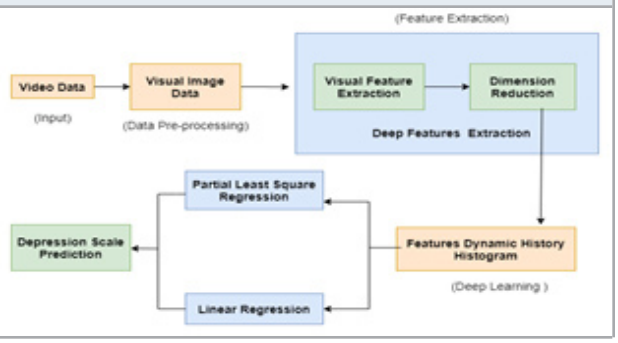
One of the most exciting developments in this area is the use of machine learning to diagnose mental illness by collecting user data from social media sites. To train the machine-learning algorithm, the researchers used clinical variables associated with suicide attempts and patients with mood disorders to train it [Al Jazaery, 2018].

C. Literature survey on Real world information: Deep and thorough literature survey is performed based on patient's condition and Doctors opinion. Information is gathered by giving visits to different clinics. Information is access and studied with the permission of Doctor. While performing depression analysis different fields of doctors opinion regarding depression is analyzed. Depression types and causes are studied in order to find out solution for prediction. Several case studies are studied regarding patient conditions to determine evaluation parameters for depression analysis.

METHODOLOGY

In our work on the problems of depression prediction and analysis, we were faced with the question of how and why with what we can predict depression. As it is based on an individual's persistent low mood, feeling of sadness, Loss of interest in particular activity, suicidal thoughts, weight loss/gain, it is a persistent problem not a passing one, average lasts for six to eight months in some cases for years. Figure 3.1 shows the architectural block diagram for proposed plan of Research work. Video will be imputed to extract frames which are responsible to record the parameters based on facial expression. Deep feature extraction takes place in this block. Dimension reduction is responsible to feature dynamic History Histogram for this action deep learning will be proposed, which again responsible for partial least square and linear regression. Depression Scale prediction block is responsible to provide output.

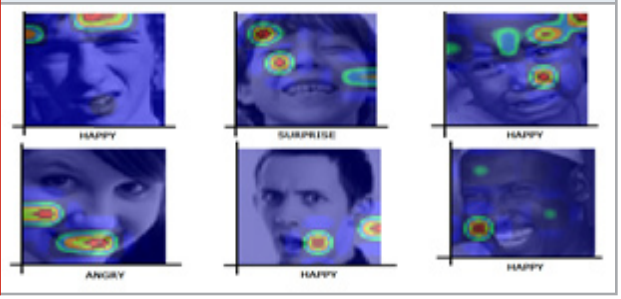
Figure 3.1: Proposed Architecture plan for Research



RESULTS AND DISCUSSION

Initial result obtained from first module is shown as below in figure 3 Feature Extraction from face using chin, eye, eye-brow and lip moment takes place via feature extraction module. We have improved the accuracy by 7%. Further there is scope of improvement by adding multiple features. Results obtained are based on parameters: Happiness, Anger, Scare, Surprise, Sad and Neutral by using Regression Technique. However we can also predict the severity of depression using BDI (Beck Depression Inventory) scale.

Figure 3: Feature Extraction from face using chin, eye, eye-brow and lip moment



CONCLUSION

Thus, we conclude that the medical illness which causes depression is a great problem which badly affects human life. Also, our model will be effectively capable of predicting depression level of patients. Consequently, our algorithm can be applied in clinical application for precise and rapid depression diagnosis, which is of incredible assistance for the front-line medical staff and is essential to control this epidemic around the world. The system contains multiple sections, which help in confirming depression levels. As the system is software based there is no requirement for human interference, unless it is a case of device failure or report of a bug. In the future, the software can be improved by switching from the database to cloud technology which can be

proven best for data handling and management issues. Much improvement can be done on security aspects by providing a 5G network which can be used for more compatibility. Predicting depression level using multimodal approaches i.e. face & clinical history information & application of deep learning techniques will improve the accuracy of existing system.

REFERENCES

Al Jazaery, Mohamad, and Guodong Guo. "Video-based depression level analysis by encoding deep spatiotemporal features." IEEE Transactions on Affective Computing (2018).

Arjun P Athreya, Ravishankar Iyer, Liewei Wang, Richard M Weinshilboum & William V Bobo, "Integration of machine learning and pharmacogenomic biomarkers for predicting response to antidepressant treatment: can computational intelligence be used to augment clinical assessments?"pharmacogenomic Vol: Published Online:27 Sep 2019https://doi.org/10.2217/pgs-2019-0119.

Ashley E. Tate ,Ryan C. McCabe, Henrik Larsson, Sebastian Lundström, Paul Lichtenstein, Ralf Kuja-Halkola, "Predicting mental health problems in adolescence using machine learning techniques, Plos one https://doi.org/10.1371/journal.pone.0230389,6th April 2020.

Chang Su, Zhenxing Xu , Jyotishman Pathak and Fei Wang, " World Health Organization. The World Health Report 2001: Mental Health: New Understanding, New Hope" World Health Organization, Switzerland, 2001.

Dham, Shubham, Anirudh Sharma, and Abhinav Dhall. "Depression scale recognition from audio, visual and text analysis." arXiv preprint arXiv: 1709. 05865 (2017).

Enrique Garcia-Ceja, Michael Riegler, Tine Nordgreen, Petter Jakobsen, Ketil J. Oedegaard & Jim Torresen "a Mental Health Monitoring with multimodal sensing and machine learning : Survey." Pervasive and Mobile Computing Journal 2018.

Jan, Asim, et al. "Artificial Intelligent system for automatic depression level analysis through visual and vocal expressions." IEEE Transactions on Cognitive & Developmental Systems 10.3 (2018): 668-680.

Pampouchidou, Anastasia, et al. "Automatic assessment of depression based on visual cues: A systematic review." IEEE Transactions on Affective Computing (2017) Vol. 10, No. 4, October-December 2019.

Radha Krishna Rambola, Akash agrawal "Autonomous Image Extraction and Segmentation Of Image using UAV'S" Published in International journal of Review Of Business and Technology Research Vol. 14, Issue no -2, 2017 (ISSN: 1941- 941).

Song, Siyang, Linlin Shen, and Michel Valstar. "Human behaviour-based automatic depression analysis using hand-crafted statistics and deep learned spectral features." 2018 13th IEEE International Conference on Automatic Face & Gesture Recognition (FG 2018). IEEE, 2018. doi: 101109/FG.2018.00032.

Zhou, Xiuzhuang, et al. "Visually interpretable representation learning for depression recognition from facial images." IEEE Transactions on Affective Computing (2018) DOI: 10.1109/TAFFC.2018.282881.