

UDC 004.8:616.895.4

Hlushenkov Dmytro Mykhailovich3rd year student

Kharkiv National University of Radioelectronics, Ukraine

Chernonos Mariia Maksymivna3rd year student

Kharkiv National University of Radioelectronics, Ukraine

APPLICATION OF MACHINE LEARNING APPROACHES IN THE DEPRESSION STUDIES AND TREATMENT

Depression is regarded as the chief cause of disability worldwide. It is a regular illness across the world having more than 264 million people affected in total [1]. Depression can lead to serious suffering and poor functioning at work, school, and in the family. In the worst cases, it can result in suicide. Despite the availability of treatments for mental disorders, in low- and middle-income countries, between 76% and 85% of people with mental health disorders are not under medical treatment [2].

Unfortunately, the causes of depression are still under research. Monoamine hypothesis, which states that depression is caused by serotonin deficit, has not been proofed. The pathogenesis of this complex disorder still remains unclear and the current available treatment for depression is also far from optimal [3]. Current research in neuroscience has gone beyond the simplistic notion of "chemical imbalance" as the cause of mental illness. The most sophisticated modern theories postulate that mental illness is caused by a complex interaction of genetics, biology, psychology, environment, and social factors.

Modern society evolves rapidly. And, unfortunately, as the level of the scientific and technical progress grows, the stress level of people also rises. According to World Health Organization, approximately 4.4% of the world's population have to deal with depression and over 75% can't receive the treatment they need.

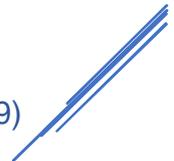
Although things such as the Center for Epidemiologic Studies Depression (CES-D) Measure are helpful instruments in recognition of depression and its severity, the causes of depression are still not studied well, so we need a different approach to it.

Presently in the psychopathology exist two different assessment paradigms – the traditional and the behavioral. And while the traditional approaches are trying to find and study the similarities between individuals, the behavioral are asserting the uniqueness of each personality (see Edelstein, Drozdick, Ciliberti 2010). Usually the combination of both methods is used when studying depression.

As mentioned previously, the CES-D is used in defining the presence and severity of depression disorders. And this measure demonstrates high effectiveness rate in depression diagnosis with Cronbach's alpha coefficient range from 0.83 to 0.85 for people from Japan, US and Taiwan[4]. But the main drawback of the questionnaire-based methods is that results always must be reviewed and corrected by a specialist based on a therapy session results while checking the current behavior of the individual. Also, even the re-examining of the CES-D results can't guarantee the correct selection of the disorder medical treatment.

Meanwhile, machine learning approaches such as combinations of MRI and pattern recognition to explore depression biomarkers are demonstrating good results in distinguishing healthy subjects from depressed and in predicting medical treatment response. Unfortunately, these methods were not integrated into clinical practices for now. One of the reasons can be the broad variety of imaging data, so it is difficult to compare the results of the data processing [5].

Unfortunately, since depression is not fully understood, the approaches to its treatment are suboptimal. The monoamine hypothesis, which connects the development of depression with a deficiency of biogenic amines such as serotonin, norepinephrine and dopamine, initiated the development of antidepressants, psychotropic drugs. There are few problems related to antidepressant treatment of depression. The first is that they do not always lead to the expected result and simply do not work. The second is that it can take weeks or even months for antidepressants



to actually start working and have a positive effect. Therefore, there are often cases when years are spent on the selection of the right treatment. Here comes the machine learning approach. A recent study [6] has shown, that AI can analyze electroencephalographic signature and predict whether the antidepressant will affect the patient or not. Another study [7] combined medical data from preceding studies of depression and used machine learning to cluster associated symptoms and developed a machine learning model to evaluate the efficacy of some major antidepressant medications.

Since depression is a complex disease, it requires complex treatment as well. Clinically depressed patients need not only medication but also psychological support. Machine learning and neural networks approaches can also be used to solve this problem. Thanks to the strong breakthrough in natural language processing in recent years, it has become possible to develop chatbots with a human-level communication.

For instance, a Woebot [8] introduced in 2017. Its work is based on cognitive behavioral therapy (CBT), a common form of psychotherapy that solves psychological problems by changing destructive patterns of thinking and behavior. For example, the chatbot advises not to use words such as "always" or "never": the phrase "I never succeed" is better to replace with a more positive one – "sometimes I make mistakes." In clinical trials involving 70 students, most of them noted significant improvements in mental health as early as two weeks after they started communicating with Woebot. According to the developers, the awareness of a person that he is talking to a robot helps to open up better - while communicating with a live psychotherapist, patients often cannot relax and stop being afraid of condemnation from him.

The research raises important questions about depression studying methods and the necessity of searching for the alternative approaches as well as the need of complex depression disorders treatment. So, the development of machine learning approaches to depression treatment and studying is significant to the society because if more effective methods are found, the consequences of the depression impacts may be decreased, and we will have better understanding of the depression disorders causes.

References:

1. GBD 2017 Disease and Injury Incidence and Prevalence Collaborators. (2018). Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*. DOI.
2. Wang et al. Use of mental health services for anxiety, mood, and substance disorders in 17 countries in the WHO world mental health surveys. *The Lancet*. 2007; 370(9590):841-50.
3. Collins P. Y., Patel V., Joestl S. S., March D., Insel T. R., Daar A. S., et al. . (2011). Grand challenges in global mental health. *Nature* 475, 27–30. 10.1038/475027a
4. Jiang et al. . (2019). Psychometric Properties of CES-D for Chinese Students
5. Shuang Gao, Vince D. Calhoun, Jing Sui (2018). Machine learning in major depression: From classification to treatment outcome prediction. *CNS Neurosci Ther*. 2018;24:1037–1052
6. Wu, W. et al. An electroencephalographic signature predicts antidepressant response in major depression. *Nat. Biotechnol*. 38, 439–447 (2020).
7. Chekroud, A., Gueorguieva, R., Krumholz, H., Trivedi, M., Krystal, J., McCarthy, G. “Reevaluating the efficacy and predictability of antidepressant treatments: a symptom clustering approach.” *JAMA Psychiatry*, vol. 74, no. 4, p. 370, 2017.
8. Fitzpatrick, K. K. et al. 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 Ment. Health* 4, e19 (2017).