Future Prospective of Soft Computing Techniques in Psychiatric Disorder Diagnosis

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1. Introduction

Psychological disorders are an anomalous condition of distress mutilation or unexpected reactions. It is an ongoing dysfunctional pattern of thoughts, emotions, and behaviour. These disorders cover a wide range of human diseases that may affect both the mental and physical state of humans [1]. These disorders may be categorized as mood disorder (depressive, bipolar and cyclothymic disorder), anxiety disorder (panic, obsessive-compulsive, post-traumatic stress, phobias), sleep and eating disorder, dissociative disorder, cognitive disorders (dementia, Parkinson, Alzheimer), Adolescence and Infancy Disorder (autism, speech disorder, attention deficit disorder with hyperactivity) and personality disorders. Biological, psychological and social causes are three major categories of causes for the development of these disorders [2]. As per the report, one-third of overall health-related problems are due to one or other psychological disorders [3-4]. Furthermore, as per the World Federation for Mental Health 2018 report, approximately 20% of youth have been suffering from one or another psychiatric disorder. Unfortunately, the prolonged presence of these disorders may further lead to several chronic and life-threatening disorders. To avoid, these types of problems the diagnosis of these human disorders should be done as early as possible.

2. Soft Computing Techniques

Soft computing is a consortium of methodologies that handles ambiguity in real-life situations. Unlike hard computing techniques, soft computing techniques are tolerant to imprecision, uncertainty as well as an approximation [5][6]. In general, these are optimization techniques that are supposed to solve real-life problems (NP-hard, NP-complete) effectively. Fuzzy logic, Artificial Neural Network (ANN), Nature-inspired Computing (NIC) techniques, stochastic reasoning and deep learning techniques are some of the major soft computing approaches:

- The idea of fuzzy logic was given by Dr Lotfi Zadeh of the University of California. Fuzzy logic deals with the degree of truth rather than the exact value such as true or false and can effectively handle imprecise or incomplete problems [7].
- An artificial neural network is a parallel computing technique that tries to mimic the working model of the brain. The neural network itself is not an algorithm, rather, it sets a framework for many different machine learning algorithms to work together and process complex data inputs [8].
- NIC methods are stimulated from different aspects of nature like humans, birds, insects, animals, water etc. There exist more than a hundred nature-inspired computing algorithms [9].
- Stochastic reasoning assists in reckoning the values for the random variable [10].
- Deep learning is based on learning data representation as opposed to task-specific algorithms. In other words, it is an emerging artificial concept that deals with emulating the learning approach of

human beings. As compared to other machine learning algorithms, deep learning algorithms are stacked in a hierarchy of increasing complexity and abstraction [11][12].

The past research revealed that various soft computing techniques have been effectively used to solve a wide variety of real-world problems like disease diagnosis [13-14], query optimization [15-17], feature selection [18-19], task scheduling [20-21], sentiment analysis [22-23],stock analysis [24] and crop prediction [25-26]which are difficult or time consuming to solve otherwise. Research related to the diagnosis of different human disorders like diabetes, cancer and cardio-problems using soft computing techniques has been witnessed. To our knowledge, no diagnosis using the soft computing techniques as mentioned in the subsequent section has been done on psychiatric disorders such as dissociative disorder, insomnia, intellectual disability, mania, anorexia nervosa, bulimia nervosa and schizophrenia. This opens new lines of research to investigate opportunities and challenges in the diagnosis of psychiatric disorders using soft computing techniques.

3. Future Prospective

The use of a hybrid approach integrating different soft computing techniques needs to be further explored for diagnosis of the aforementioned psychiatric disorders. There is a potential scope to use and explore the effectiveness of different emerging nature-inspired computing techniques like Grey Wolf Optimizer [27], Crow Search Algorithm [28], Harris Hawks Optimizer [29], Artificial Feeding Birds [30], Ant Lion Optimizer [31], Gartener Snake Optimization [32], Spotted Hyena Optimizer [33], Elephant Herding Optimization [34], Emperor Penguins Colony [35], Whale Optimization Algorithm [36] in diagnosis of different human psychological disorders. These techniques and their hybrid approaches can be employed to select optimal data set features to get a better data classification rate. The performance metrics like precision, recall, F1-score, rate of classification, rate of misclassification along with other statistical measures for these techniques should be deeply studied and examined as the quality and overall performance of the diagnostic system has been greatly depended upon these parameters. Due to the unbalancing of parameters and stochastic nature, sometimes the output of the NIC algorithm may get stuck in a dilemma called local maxima. To overcome these problems, binary and chaotic variants of the different NIC algorithm have been proposed. A chaotic version of the algorithm makes use of different chaotic sine, iterative, logistics, circle, tent, Chebyshev, singer and Sinusoidal. More effort is required to explore the use of binary or chaotic variants of these emerging NIC techniques for the diagnosis of these psychiatric problems. The different factors such as instability in the patient, insufficient time for collecting

diagnostic data, diagnostic error along with the high volume of data, the intricacy and uncertainty in the disease diagnosis process has been increased. In contrast to the real value, the fuzzy logic techniques like fuzzy expert system, fuzzy set theory, fuzzy classification, fuzzy cognitive map, rule-based fuzzy logic, weighted fuzzy rule assist along with adaptive neuro-fuzzy inference system in detecting the degree of membership for different psychiatric disorders [37]. In simple terms, for handling imprecise and incomplete data, the use of fuzzy logic, rough set and stochastic reasoning can be an added advantage. To further improve the quality of the diagnostic system, the deep learning techniques like Deep Neural Network (DNN) [38], Deep Belief Network (DBN)[39], Restricted Boltzmann Machine (RBM) [40], and Convolutional Neural Network (CNN)[41] should be preferred to process the data presented in the form of images, audio and video signals. Finally, the emerging deep learning model like variational auto-encoders (VAEs) and generative adversarial networks (GANs) can be effectively used in solving unsupervised learning problems [42].

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