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ORIGINAL ARTICLE

A neuro-fuzzy approach for the diagnosis of depression

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Abstract Depression is considered to be a chronic mood disorder. This paper attempts to mathematically model how psychiatrists clinically perceive the symptoms and then diagnose depression states. According to Diagnostic and Statistical Manual (DSM)-IV-TR, fourteen symptoms of adult depression have been considered. The load of each symptom and the corresponding severity of depression are measured by the psychiatrists (i.e. the domain experts). Using the Principal Component Analysis (PCA) out of fourteen symptoms (as features) seven has been extracted as latent factors. Using these features as inputs, a hybrid system consisting of Mamdani's Fuzzy logic controller (FLC) on a Feed Forward Multilayer Neural Net (FFMNN) has been developed. The output of the hybrid system was tuned by a back propagation (BPNN) algorithm. Finally, the model is validated using 302 real-world adult depression cases and 50 controls (i.e. normal population). The study concludes that the hybrid controller can diagnose and grade depression with an average accuracy of 95.50%. Finally, it is compared with the accuracies obtained by other techniques.

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1. Introduction

Medical decision making as a whole is a complex process due to handling of higher dimensional, raw, and subjective clinical data. Correct decision requires an orchestration of clinician's high level perceptions and intuitions toward understanding a disease process. Correctness of the diagnosis depends on the number of times symptoms are matched with the representatives of the reference diseases (which are called as 'classical' cases). Manual diagnosis is often individualized and so as the presentation of an illness. Therefore, the appropriateness of the term classical becomes relative in clinical medicine. Applications of higher data mining technique(s) and concepts of computational intelligence have tremendous research scopes in modeling the process of clinical diagnosis due to its operational resemblance. It also invites an opportunity for the cross-disciplinary research.

1.1. The manual process of medical decision making (Chattopadhyay, 2007)

In medical decision making there are basically two major phases. The first phase is known as the *differential diagnosis* (*DD*) and the second phase is termed as *provisional* or *final diagnosis* (*PD*). During *DD*, patients' history and sign-symptoms are perceived by the clinicians as the inputs. This information, in turn, is processed or analyzed according to their medical knowledge-base and experience to arrive into a diagnosis of overlapping look-alike diseases. According to the perception, medical doctors possibly assign some arbitrary weights to symptoms to define its level of representation on the overall disease load. Through multiple clinical assessments (i.e., iterations in computer science term), such weights are repeatedly evaluated and if required, updated. In clinical medicine there might be chances where different diseases present with similar patterns and vice versa. Hence, based on the inputs, doctors try to match the symptom patterns with classical case of each of the possible diseases (obtained during *DD*) by measuring the similarity. Based on the degree of similarity, they then rank the possible diseases and management strategies proposed aiming at the top most ranked disease. Results of the investigations and the preliminary treatment are closely matched with all plausible diseases (obtained during *DD*) and finally best matched disease is diagnosed. This process is referred to as *PD*. However, in reality, the process is not so trivial and straight forward. There are several iterations, needed to arrive from *DD* to *PD*. Fig. 1 shows the schematic representation of clinical diagnosis process.

1.2. Complexities in depression diagnosis

Psychiatry is the most complex domain in Medical sciences. Psychiatric diseases are not directly measurable due to vague symptomatic presentations. Results of investigations and treatment are manually correlated with the course of morbidity and such correlations could lead to biased decision-making.

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