



Multimodel decision support system for psychiatry problem

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ABSTRACT

Psychological distress and disabilities are increasingly identified among general population. Psychiatrist availability in rural areas is poor and often general practitioners have to identify and treat psychiatric problems like depression and anxiety. This work proposes a method to identify the psychiatric problems among patients using multimodel decision support system. Backpropagation neural networks (BPNN), radial basis function neural network (RBFNN) and support vector machine (SVM) models are used to design the decision support system. Forty-four factors are considered for feature extraction. The features are collected from 400 patients and divided into four sets of equal size. Three sets of patient features are used to train the decision support system and one set of patient feature is used to evaluate performance of the system. Experimental results show that the proposed method achieves an accuracy of 98.75% for identifying the psychiatric problems.

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1. Introduction

On analyzing recent development, it becomes clear that the trend is to develop new methods for decision making using computers in psychiatry and to evaluate these methods in practice. Medical expert systems help doctors to determine definitive diagnosis or a range of alternative diagnoses.

The conventional approach to build medical expert systems requires the formulation of rules by which the input data can be analyzed. But the formulation of such rules is very difficult with large sets of input data. Realising the difficulty, pattern classification techniques such as artificial neural networks (ANN) have been applied as an alternative to conventional rule-based expert systems. ANN can be trained without encapsulating the knowledge derived from these rules. Hence ANN has been found to be more helpful than a traditional medical expert system in the diagnosis of diseases. For example, patients may not have similar signs and symptoms when the disease is the same. In addition, the disease of the patients cannot be classified into single class unless some more measurement and tests are made to solve ambiguity.

1.1. Overview of psychiatry problem

Computers could have a role in supplementing patient assessments, diagnosis and treatment in a variety of clinical settings (Bremer & Beresin, 2000). A number of software tools are being designed and are already in use (Weiner & Pifer, 2000). These tools

are found useful in administrative, data management and in clinical experiments. These tools reduce time and minimize errors in medical practice. The clinical decision support system synthesizes and integrates patient specific information, performs complex evaluations and presents the results to clinicians in a timely fashion (Hunt, Haynes, Hanna, & Smith, 1998). In India most of the health care burden is at the primary care level. The primary care physicians often have to manage a variety of clinical decisions themselves (Jacob, 2006). Computers may be of immense benefit to them. Decision support systems may enable the doctor to assess his performance and improve his diagnostic accuracy. Psychiatric problems are very common and cause significant delay in recovery and often require costly investigations before coming to its diagnosis (Salmon, Dowrick, & Ring, 2004).

1.2. Psychiatric problems in primary care settings

There is a growing literature demonstrating the psychiatric problem that is present in developing countries. At least 50% of the patients attending the primary care setting have psychological problems (Jacob, 2004). It is also observed that emotional symptoms are expressed in body terms. The body symptoms are an expression of personal and social distress. This process is known as somatisation. Patients with this kind of presentations are called somatisers and their presentations of symptoms are also called as unexplained medical symptoms (Salmon et al., 2004).

The somatisers have significant psychiatric problems. Anxiety and depressive disorders are the commonest diagnosis in them. Hence they need psychiatric treatment rather than medical treatment. The somatisers also do not have diagnosable medical

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problem and undergo extensive investigations. This results in loss of time for the doctor and produce huge burden to the health care delivery system (Salmon, Dowrick, & Ring, 2005).

Attempts are made to systematically interview them and screen for psychiatric diagnosis. Thereby the patients may be identified earlier and treated by psychiatrists. This approach has led into a predictive model for abnormal illness behaviours and somatisation. Those found to have these problems are screened for depression or anxiety disorders and are treated with psychiatric drugs (Lewis, Pelosi, & Arya, 1992).

In most of the countries the primary care settings availability of psychiatrists are rare. For example there are only 3000 psychiatrists for the population of more than 115 crore in India. At the primary care level and at the district level too the problem of poor psychiatric services are common. Therefore physicians and other specialists are made to treat the psychiatric problems. The somatising patients pose a major burden on them. The prevalence of somatisation is considered to be higher than in western countries (Jacob, 2006).

In order to help the physicians decision support system may be of immense value. The system should enable the primary care physician to screen for depression or anxiety on the patients whom he suspects mental illness or somatisation or abnormal illness behaviours. Thereby these patients can be identified and treated with drugs or psychotherapy at primary care level or may be referred to psychiatrists.

1.3. Problems faced in clinical decision support systems

There are certain general problems in preparing clinical decision support systems (CDSS). It is not possible to create CDSS because there is no electronic medical records (EMR) at primary care level. Technologies are not yet widely available to most hospitals and many electronic data information standards not yet been adopted industry-wide. One of the most difficult barriers is the development of a standardized EMR. There are no defined set of recommendations for an EMR and no industry-wide standard for EMR (Morrissey, 2001). Due to the limited implementation of computer-assisted diagnostic and management tools only a few evaluations have been conducted and no definitive conclusions have been reached from the CDSS.

The objective of this work is to identify the psychiatric problems using decision support system. The decision support system is designed using backpropagation and radial basis function neural networks. Section 2 presents the literature review on existing decision support systems. Section 3 describes backpropagation, radial basis function neural network and support vector machine models. Experimental results are given in Section 4. Section 5 concludes the paper.

2. Literature review on decision support system

Decision support system play a major role in health-care. There are only a few computerised clinical decision support systems for psychiatry problems. In Trivedi, Kern, Grannemann, Altshuler, and Sunderajan (2004), the authors have designed and developed a computerised decision support system for the treatment of major depressive disorder using evidence based guidelines. They have transferred the knowledge gained from the Texas medication algorithm project (TMAP). This computerised decision support system (compTMAP) provides support in diagnosis treatment follow up and preventive care. This system can be incorporated into the clinical setting. Harmonex group of medical experts and software technologists have developed a system for the use of mental health settings. By using electronic medical records they have devised

decision supporting systems. The harmonex neuroscience research division (NSR) deals with schizophrenia, bipolar disorders, depression, anxiety, ADHD and other psychiatric syndromes. A Brazilian university group of psychiatrists have devised a system for diagnosing schizophrenia (Razzouk, Mari, Shirakawa, Wainer, & Sigulem, 2006). The system is called SADDESQ is modeled for the use of students in psychiatry to diagnose psychotic disorders. The knowledge is initially extracted from clinical interviews. These interviews are aimed to explore the experts decision making process. A graph methodology was employed to identify the elements involved in the reasoning process. This knowledge is organised and modeled by means of algorithms and transferred to computational model created by the covering approach.

3. Decision support system for identifying the psychiatry problems

The psychiatry problems among patients can be identified using multimodel decision support system. In this work, backpropagation and radial basis function neural networks are used to construct the system. Artificial neural networks (ANNs) are intelligent systems that are related to a simplified biological model of the human brain. They are composed of many simple elements, called neurons, operating in parallel and connected to each other in the forward path by some multipliers called the connection weights. Neural networks are trained by adjusting values of these connection weights between the network elements. Neural networks have self learning capability, are fault tolerant and noise immune, and have applications in system identification, pattern recognition, classification, speech recognition and image processing, etc. (Venayagamoorthy, Moonasar, & Sandrasegaran, 1998). ANNs are potentially useful for studying the complex relationships between inputs and outputs of a system. Backpropagation and radial basis function neural networks are described in the following subsections.

3.1. Backpropagation neural network (BPNN)

Backpropagation neural network is a feed forward neural network used to capture the relationship between the inputs and outputs (Poh, 1991). In this work, a three layer feedforward neural network as shown in Fig. 1 is used with hyperbolic tangent ($\tanh()$) as activation function. The neural network is trained using backpropagation algorithm (Haykin, 2003).

In the backpropagation training algorithm the error in the output neuron q is given by

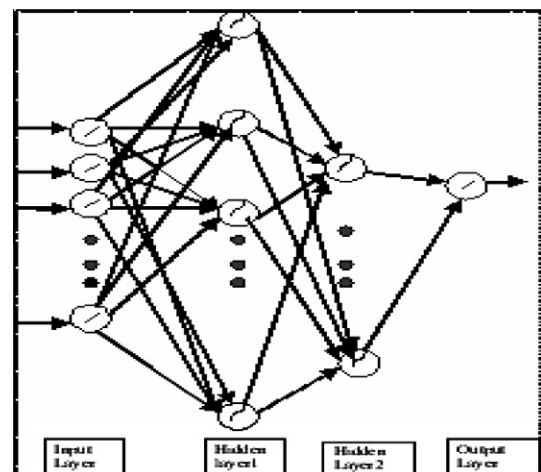


Fig. 1. Backpropagation neural network.

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