Chapter 1
Conventional and Non-Conventional ANNs in Medical Diagnostics:
A Tutorial Survey of Architectures, Algorithms, and Application

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ABSTRACT

Computer technology advancements in recent days have offered professionals in different fields the ability to gather data, process information, store, and retrieve at a faster rate and make effective decisions. The large collection of data among all various applications including medical diagnosis has paved the need to employ advanced artificial neural networks (ANN). This chapter provides a detailed working view of ANN, covering its various architectures and design techniques in brief. A detailed analysis and summary of medical diagnostics applications using various ANN techniques will be leveraged. Imbalanced data is the major problem with medical data. This chapter briefs on the various methods to handle imbalanced data. Finally, future directions and potential current challenges are suggested for additional applications in neural networks.

DOI: 10.4018/978-1-7998-5071-7.ch001

INTRODUCTION

In recent time's artificial neural networks (ANNs) has become a popular and helpful model for classification, clustering, pattern recognition and prediction in many disciplines including medical. ANNs are one category of the of machine learning (ML) and has become relatively competitive to conventional regression and statistical models regarding usefulness (Dave, 2014). Currently, artificial intelligence, information security, big data, cloud computing, internet, and forensic science are all hotspots and exciting topics of information and communication technology (ICT). ANNs full applications can be evaluated with respect to data analysis factors such as accuracy, processing speed, latency, performance, fault tolerance, volume, scalability and convergence (He, 2009; Muzoffair, 2018). The great potential of ANNs is the high-speed processing provided in a massive parallel implementation and this has heightened the need for research in this domain (Izebudien, 2014). ANNs can be developed and used for image recognition, natural language processing and so on. Nowadays, ANNs are mostly used for universal function approximation in numerical paradigms because of their excellent properties of self-learning, adaptivity, fault tolerance, nonlinearity, and advancement in input to an output mapping (Wang, 2018). In (Raval, 2016) usage of machine learning techniques for medical diagnosis analysis of disease considering reports of lab and symptoms for acute analysis is considered.

Scope of the Work

ANN for medical diagnosis is an active research area currently, and researcher's estimates to it to be more widely used in biomedical systems for next few decades as its result are restricted to linear form. ANN will identify disease by learning method without using details of how to recognize the disease, hence it doesn't require any algorithm to identify disease.

ANNs has significant advantages over statistical models, when both are relatively compared. In ANN models, there are no assumptions about data properties or data distribution. Therefore, ANNs are more useful in practical application. Also, unlike some statistical models that require certain hypothesis for testing, ANN models do not require any hypothesis. ANNs are very flexible, data reduction models, encompassing nonlinear regression models, discriminant models, and more fault tolerant. That is, they can handle incomplete and noisy data; and can solve non-linear problems, Also, trained ANNs, can generalize at high speed and make predictions. Furthermore, ANNs are scalable when relatively compared to support vector machine, extreme learning machine, and random forest. ANN processing is promising in several areas of medical analysis such as glucose monitoring (Catalogna, 2012), blood disorders (Raval,2018), diagnosis of various health related issues related to heart (Mihaela,