

Contribution of Neural Networks in Medicine

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Abstract: Artificial intelligence is an emerging field in Medical field nowadays. The demands and expectations by general public regarding medical AI could provide guidance for the future development of medical AI to satisfy the increasing needs of doctors and patients. This paper reviews the various research analysis done on neural networks in medical science.

Keywords: Artificial Neural Network (ANN), artificial intelligence (AI), depth of anesthesia (DoA), electroencephalogram (EEG).

Introduction

Artificial Neural Network is a paradigm of Artificial Intelligence that has taken its inspiration from biological neuron (human brain). It simulates the information processing capabilities and learning capability of the biological neuron [1]. The Neural Networks are best at identifying patterns or trends in data and they are well suited for predicting or forecasting. Hence neural networks are extensively applied to biomedical systems. Artificial neural networks are composed of interconnecting artificial neurons. This network may either be used to gain an understanding of biological neural networks, or for solving artificial intelligence problems [2].

Artificial neural networks provide a powerful tool to help doctors to analyze, model and make sense of complex clinical data across a broad range of medical applications. Most applications of artificial neural networks to medicine are classification problems; that is, the task is on the basis of the measured features to assign the patient to one of a small set of classes [3].

Literature review:

Artificial Intelligence (AI) in medicine and biological research is tremendously a powerful tool. One of the most interesting and extensively studied branches of AI is the 'Artificial Neural Networks (ANNs). ANN is the simulation of biological neural cluster that learns from data and extract knowledge contained in the data. This digitized model of biological brain is widely used for medical applications and has been extensively used for diagnosis, medical image analysis and radiology, for modeling in medicine and clinical research [4,10]

Intelligent Diagnosis Using Neural Network

The advancements in medical AI services, intelligent diagnosis, such as disease prediction, and health monitoring, is possible with the advancements in medical AI service. However, this new medical model also introduces concerns and controversies, typically regarding its accuracy and safety. In many medical areas, including imaging and pathology departments, outpatient services, and surgery, there is a strong demand for intelligent assistance, which is possible only by the advantageous implementation in medical AI.

Early intelligent detection of health issues, medical interventions among home-dwelling patients, have been reported to increase medical adherence and healthy behaviors by various AI-aided services. The advancements in medical AI has proved to be a powerful tool to revolutionize elderly care for the betterment. For example, it is possible to monitor the physical condition of the elderly people by introducing an intelligent virtual health manager, as a result which will help them develop healthy life habits. Further, for severely ill elderly patients, nursing robots has been introduced, providing medical services and assisting them with daily living.[7]

Why call for neural network?

The field of computer science provides expert techniques for efficient medical diagnostics of various diseases. These expert systems are AI techniques that help the medical professionals to efficiently diagnose particular disease based on the symptoms in the data set with less error and better accuracy[4,13]. One such technique is AI that has been used in diagnosing diseases such as Diabetes, Heart disease, Thyroid and so on [14,15]. The capability of self-learning, high parallelism strength(parallel processing), reusability,

high speed and error tolerance make artificial neural network/Connection oriented network a proper techniques for medical diagnosis. Being included with back propagation learning, feed forward neural network is imparted with supervision learning wherein the labeled training dataset is being provided to train the network in the first phase. Further the model is being validated and tested to check for the minimized error.

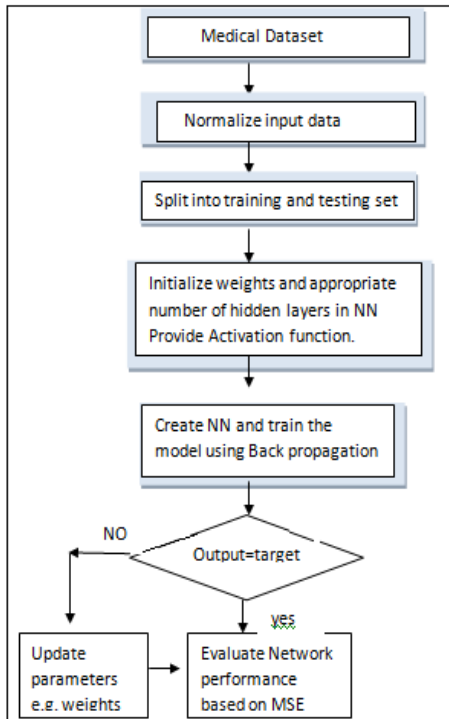


Fig 1: Process of Neural Network

Figure1 above shows the process of learning in neural network using back propagation technique wherein in each iteration the focus is on minimization of error for better accuracy.

Following lists some of the important research on common encountered diseases in humans which have been diagnosed using the Artificial neural network.

I. ANESTHESIA CONTROL USING NEURAL NETWORK

Clinicians and researchers have been worked very hard to improve patient monitoring systems[5]. During surgery, General anesthesia is necessary and important during surgery to ensure the safety of patients. Both Overdose anesthesia & inadequate anesthesia results in worst condition for patients.

The former leads to longer recovery time, & the latter leads to intraoperative awareness and psychological effects on patients [6, 9 and 11]. But with the help of Artificial intelligence of neural network, reliable monitoring depth of anesthesia (DoA) is possible which was a great concern for anesthesiologist.

The various clinical indices and techniques used such as blood pressure and heart rate have proved unreliable for assessing depth of anesthesia DoA. The electroencephalogram (EEG) originating in CNS as affected by the anesthetic drug has been widely used in monitoring the DoA. The electroencephalogram (EEG) contains abundant information of different anesthetic states of the brain and can reflect the brain activity.

In this study, we propose a method that combines multiple EEG-based features with artificial neural network (ANN) which proved to be promising to access monitor the DoA. Multiple combination of electroencephalogram (EEG) can express the states of the brain well during anesthesia. The proposed method showed the results that could easily distinguish between awake and other anesthesia states. [6]

II. Modeling And Diagnosing The Cardiovascular System Using Neural Network

A cardiovascular model can be developed from the physiological measurements of an individual. For the diagnosis purpose ,any difference between the modeled variables and the variables of an individual at a given time is used. The physiological variables (ie heart rate, systolic and diastolic blood pressures and breathing rate) at different physical activity levels are made to mimic with the model of an individual's cardiovascular system. A model for a healthy individual is marked by comparing with the actual measurements of that individual at a later time. To evaluate and diagnose medical conditions affecting the cardiovascular system of that individual can be seen by any difference in the above comparison.

The cardiovascular model has been shaped up with the artificial neural network (ANN) technology. The ANN technology enables us to automatically develop the model without any cardiovascular expert. The early prediction of any undesired medical condition can be possible with the real time diagnosis, reducing the response time of medical help for people. In addition the people with medical conditions in nursing home and in home care situations can be continuously monitored.

Because of ANN's several capabilities including the sensor fusion, the ANN technology is best suited for the cardiovascular modeling. The overview of complex relationships among the individuals sensor by ANN with the help of sensor fusion is possible, which would not have possible or lost if the values were analyzed individually[8].

III. DIAGNOSING DIABETES USING NEURAL NETWORK

Apart from heart disease, various diseases that may have risk of occurring due to diabetes include kidney disease, nerve damage, blindness and blood vessel damage. So Diabetes disease diagnosis is an important issue that is solved using AI. Research has been performed [12] wherein a multilayer neural network structure has been used for classification.

Conclusion:

This paper emphasizes the importance of neural network in medical science. Further it is not claimed that the method for electroencephalographic data processed by neural network-based is the best possible, but this combination has conclusively demonstrated its potential and efficiency for providing anesthesiologists a complementary and reliable tool for monitoring patient anesthesia. In addition, with the aid of intelligent ANN, it could provide guidance for the development of reliable intelligent healthcare. Neural network helps in early prediction of any undesired medical condition with the real time diagnosis, reducing the response time of medical help for people.

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