USE OF ARTIFICIAL NEURAL NETWORK IN MEDICINES

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Abstract:-

Medicine has always benefited from the forefront of technology. Technology advances like computers, lasers, ultrasonic imaging, etc. Have boosted medicine to extraordinary levels of achievement. Artificial neural networks (ann) is currently the next promising area of interest. It is believed that neural networks will have extensive application to biomedical problems in the next few years. Already, it has been successfully applied to various areas of medicine, such as diagnostic systems, biochemical analysis, image analysis, and drug development.

1.0 Introduction

Neural network (nn) in medicine has attracted many researchers. A simple search by machado (1996) in medline for articles about computer-based nn between 1982 and 1994 resulted with more than 600 citations. Another search by dybowski (2000) in the same database yields 473 publications in 1998. According to dybowski, nn in medicine is subjected to increase, as the numbers of experts are limited while interpretation work at clinical laboratories is subjected to mounting. Furthermore, the complexity of patient related data could easily overlooked even by the specialist. Nns have been implemented in many applications. Kemsley et al. (1992) describes the potential impact of nn in real world applications. Several applications was reviewed and evaluated based on the model used, input and output data, the results and project status. From the review, several research and applications of neural expert system in medical applications have been listed. Most of the research that employed nn yields between 70% to 80% accuracy.

Nn has been shown as a powerful tool to enhance current medical diagnostic techniques. Partridge et al. (1996) listed several potentials of nn over conventional computation and manual analysis in medical application:

- Implementation using data instead of possibly ill defined rules.
- Noise and novel situations are handled automatically via data generalization.
- Predictability of future indicator values based on past data and trend recognition.
- Automated real-time analysis and diagnosis.
- Enables rapid identification and classification of input data.

Eliminates error associated diagnostic systems

anns are extensively used in diagnostic systems. They are normally used to detect cancer and heart problems. The benefits of using anns is that they are not affected by factors such as fatigue, working conditions and emotional state.
Biochemical analysis
anns are used in a wide variety of analytical chemistry applications. In medicine, anns have been used to analyse blood and urine samples, track glucose levels in diabetics, determine ion levels in body fluids, and detect pathological conditions such as tuberculosis.

Image analysis
anns are used in the analysis of medical images from a variety of imaging modalities. Applications in this area include tumour detection in ultrasoundograms, classification of chest x-rays, tissue and vessel classification in magnetic resonance images (mri), determination of skeletal age from x-ray images, and determination of brain maturation.

Drug development
anns are used as tools in the development of drugs for treating cancer and aids. Ann are also used in the process of modelling biomolecules.

- With human fatigue and habituation.

Sarle (1994) describe the usage of nn in three main ways, typically, as models of biological nervous systems and “intelligence”, as real-time adaptive signal processors or controllers implemented in hardware and as methods for data analysis. Passold et al. (1996) summarized the benefits of neural networks as follows:

- Ability to process a massive of input data
- Simulation of diffuse medical reasoning
- Higher performances when compared with statistical approaches
- Self-organizing ability-learning capability
- Easy knowledge base updating

Proposed works:
applications of neural network in medicine

In this paper the discussion of applications of neural network in medical applications is divided into several domain that are applications in basic sciences, clinical medicine, signal processing and interpretation and medical image processing.

Applications in basic sciences

In basic sciences, nn helps clinician to investigate the impact of parameter after certain conditions or treatments. It supplies clinicians with information about the risk or incoming circumstances regarding the domain. Learning the time course of blood glucose (prank et al., 1998) for example can help clinician to control the diabetes mellitus. Prank et al. Uses feed forward nn for predicting the time course of blood glucose levels from the complex interaction of glucose counter regulatory hormones and insulin.

Multi-layer perceptron (mlp) with sigmoidal feed-forward and standard back-propagation (bp) learning algorithm was employed as a forecaster for bacteria-antibiotic interactions of infectious diseases (abidi and goh, 1998). They conclude that the 1-month forecaster produces output correct to within occurrences of sensitivity.
However, predictions for the 2-month and 3-month are less accurate.

Applications in clinical medicine

Patient who hospitalize for having high-risk diseases required special monitoring as the disease might spread in no time. Nn has been used as a tool for patient diagnosis and prognosis to determine patients’ survival. Bottaci and drew (1997) investigate fully connected feed forward mlp and bp learning rule, were able to predict patients with colorectal cancer more accurately than clinicopathological methods. They indicate that nn predict the patients’ survival and death very well compared to the surgeons.

Pofahl et al. (1998) compare the performance of nn, ranson criteria and acute physiology and chronic health evaluation (apache ii) scoring system for predicting length of stay (los) more than 7 days for acute pancreatitis patients’. Their study indicates that nn achieve the highest sensitivity (75%) for predicting los more than 7. Ohlsson et al. (1999) presents their study for the diagnosis of acute myocardial infarction. In their study nn with 10 hidden nodes and one output neuron have been used as the classifier to classified whether the patient suffered from acute myocardial infarction (1) or not (0). The results show that nn performance is 0.84 and 0.85 under receiver-operating characteristics (roc).

Applications in signal processing and interpretation

Signal processing and interpretation in medicine involve a complex analysis of signals, graphic representations, and pattern classification. Consequently, even experienced surgeon could misinterpret or overlooked the data (janet, 1997; dybowski, 2000). In electrocardiographic (ecg) analysis for example, the complexity of the ecg readings of acute myocardial infarction could be misjudged even by experienced cardiologist (janet, 1997). Accordingly the difficulty faced in ecg patient monitoring is the variability in morphology and timing across patients and within patients, of normal and ventricular beats (waltrous and towell, 1995).

(lagerholm et al., 2000) employed self-organizing neural networks (self-organizing maps or soms) in conjunction with hermite basis function for the purpose of beat clustering to identify and classify ecg complexes in arrhythmia. Soms topological structure is a benefit in interpreting the data. The experimental results were claimed to outperform other supervised learning method that uses the same data.

Analysis of nn as ecg analyzer also proves that nn is capable to deal with ambiguous nature of ecg signal (silipo and marchesi, 1998). Silipo and marchesi use static and recurrent neural network (rnn) architectures for the classification tasks in ecg analysis for arrhythmia, myocardial ischemia and chronic alterations. Feedforward network with 8-24-14-1 architecture was employed as a classifier for ecg patient monitoring (waltrous and towell, 1995). The analysis indicated that the performance of the patient-adapted network was improved due to the ability of the modulated classifier to adjust the boundaries between classes, even though the distributions of beats were different for different patients.

Multi layer rnn performance with 15-3-2 architecture had been studied and the performance of nn is compared with conventional algorithms for recognizing fetal heart rate abnormality (lee et al.,
The study reveals that the performance of nn is exceptional compared to conventional systems even with adjusted thresholds.

Ahmed and Farag (1998) use two self-organizing maps (som) in two stages, self-organizing principal components analysis (sopca) and self-organizing feature map (sofm) for automatic volume segmentation of medical images. They performed a statistical comparison of the performance of the sofm with hopfield network and isodata algorithm. The results indicate that the accuracy of sofm is superior compared to both networks. In addition, sofm was claimed to have advantage of ease implementation and guaranteed convergence.

Discussion or future aspects:

Nn have been successfully implemented in many applications including medicine. Nn, which simulates the function of human biological neuron, has potential of ease implementation in many applications domain. The main consideration of nn implementation is the input data. Once the network is train, the knowledge could be applied to all cases including the new cases in the domain. Studies have shown that nn predictive capability is a useful capability in medical application. Such capability could be used to predict patient condition based on the history cases. The prediction could help doctor to plan for a better medication and provide the patient with early diagnosis.

Conclusion

Anns have a lot to offer to modern medicine. At the moment they are mainly used for pattern recognition using images but experiments are being done in using anns to model parts of the human body. The high computation rates of anns are vital to telemedicine which is a ‘hot’ research area at the moment. Neural networks will never replace human experts but they can help in screening and can be used by experts to double-check their diagnosis.

Reference

