ABSTRACT

In this century technological innovation has progressed at such an accelerated pace that it has permeated almost every facet of our lives. This is especially true in the field of medicine and the delivery of health care services. Today, in all the developed countries, the hospitals with a view to give immediate medical treatment have emerged as centres of modernized and technologically sophisticated health care systems.

This thesis involves the implementation of soft computing methodologies comprising of Neural Networks, Fuzzy Logic and Evolutionary algorithms and Signal Processing methods like Wavelet Transforms and Hidden Markov Model to develop an intelligent system that detects the presence of epileptic patterns in Electroencephalograph (EEG) signals thereby automating the procedure of the electroencephalographer.

A digital waveform recognition system has been developed to detect the patterns. This system receives the digitized waveform as input, evaluates a feature set for the input measurement and then classifies the waveform based on the feature values. The time series constituted by the sampled EEG is analysed by the method of Linear prediction. Linear prediction makes use of the difference in stationarity of the background and epileptic EEG.

A Neural Network based epileptic pattern detector has been proposed. The drawbacks of conventional Backpropagation algorithm for training feedforward Neural Networks is modified with an objective of quick training. Adaptive Backpropagation algorithm and Fast Backpropagation algorithms have been found to converge faster.

The conventional BP method suffers from the drawbacks of local minima problem and slow convergence. In the light of the above disadvantage, a Hybrid model

involving Neural Network that is tuned using Adaptive Genetic Algorithm (AGA) and Differential Evolution (DE) is proposed. This hybrid model provides a powerful technique for combining gradient descent methods with evolutionary optimization strategies encompassed in Genetic Algorithms and Differential Evolution. Due to inherent simplicity of the algorithm and its robustness, convergence is quicker and better results are obtained in this hybrid model.

An EEG signal detector that explicitly characterizes uncertainty is constructed using fuzzy logic with membership functions based on the observed values of waveform features. The Fuzzy detector developed combines the evidences from two waveform features namely, Mean Square amplitude ratio and Cross Correlation Coefficient and includes a measure of uncertainty in the decision.

An EEG signal classification system using Wavelet Transform with Multi-Resolution analysis is developed. The decomposition of the signal into different frequency bands suits well for the detection of various abnormalities in the EEG. The wavelet coefficients of the EEG signal are classified using Template matching and Backpropagation Neural Network.

Hidden Markov Model (HMM) is a powerful tool for providing a statistical model of both the background activity and the abnormal events that occur in EEG. A HMM is a finite-state statistical model, useful for modeling nonstationary signals whose time varying characteristics are described through a chain of statistical states. In this thesis, Hidden Markov Model is developed for the normal as well as abnormal EEG. This technique requires computationally intensive training, but relatively simple verification procedures.