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Research Article

SUITABILITY OF NEURAL NETWORK FOR MEDICAL DATA DIAGNOSIS: A COMPREHENSIVE LITERATURE REVIEW

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ABSTRACT

Diagnosis of medical data is a complex and challenging task for a medical scientist. It is almost complicated due to chaos behavior of medical data. However, since 1986 neural network based numerical modeling for the same is suggested by the world's scientific community and shown some extent of success. In this study, comprehensive reviews of various contributions (1990 to 2016) have been done. Where different models from various contributors have been studied year wise. As a result, soft-computing i.e., neural network, deep learning technique, data mining technique such as associative classifier has been found to be successfully applied. In neural network based numerical modeling two different architectures of neural network such as BPN and RBF were found more suitable while BPN was better evaluated over RBF architecture as far as performance and complexity of implementation is concerned. Finally, it is concluded that BPN is sufficient to resolve this complex problem. It has shown 90% accuracy in modeling. However, obtaining optimum architecture for better performance is a pre-requisite. These evidences have been broadly discussed in this review paper.

INTRODUCTION

Accurate and ideal diagnosis of medical data through modeling has been challenging for scientists along with engineers of medical sciences since decades and centuries. To overcome this challenge, the mathematical modeling and computation may play significant roles. Different techniques have been employed, with various improvements to get accurate diagnosis. However, the diagnosis is quite difficult due to presence of complex nonlinear relationships dependent and independent parameters of medical data set. And also this data set is representing chaotic in nature. From 1986, Artificial Neural Networks (ANNs) has emerged as a powerful computing system for extremely complex and non-linear systems (chaos) such as climate, runoff etc. ANNs belongs to the black box time series models and offers a relatively flexible and quick means of modeling. These models can treat the non-linearity of system to various extents due to their parallel architecture. However, various architecture of ANNs is utilized in non-linear system. It is found that the architecture of ANNs is depending on the problem space.

The aim of this study to be categorized ANNs in medical data diagnosis and their applicability without any scientific controversy. For the objectives of this study are to identify all methods including ANNs for medical data diagnosis up to till date and their performances and evaluate the performance of ANNs. These objectives are considered via comprehensive review of literature from 1991-2017. It is found that, several methods are used including ANNs. Although, ANNs are found suitable without any controversy. However, detail of discussion concerning the architecture of ANN for the same is rarely visible in the literature; while various applications of ANNs are available.

In this study the review of these contributions is accomplished. And tried to identify that neural network is sufficiently suitable for modeling of chaotic data sets. Since medical data sets is also an illustration of chaotic nature thus various contributions was reviewed to identification of suitability of neural network for medical data diagnosis.

This Paper has been constructed with the sections. Section II discussed comprehensive review of world-wide contribution from 1990 to 2016. Neural network techniques for medical data diagnosis those are unquestionably accepted and no scientific disagreements are discussed finally conclusions of the study are described in the section III.

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COMPREHENSIVE LITERATURE REVIEW

The significant and north worthy contributions in the field of medical data diagnosis from 1972 to 2016 are reviewed and identified fundamental and vital methodologies. The major contributions are discussed in this section. The primary objective of this research is to develop a model for diagnosis. It is found that medical data series is in chaotic in nature. Lorenz (1972), has described the Chaos, as that when the present determines the future but approximate present does not approximately determines the future. Chaotic behavior is being observed in many natural systems. Various contributions are available in mathematics, statistics, and computer sciences as far concern of modeling for forecasting future values from present and past recorded accurate values in chaotic system as described in following sections. This section describes all methods for suitability of neural network for forecasting of chaotic data and medical data diagnosis in year wise.

From Rumelhart *et al*. (1986), the ANNs have been proved to be a powerful soft computing technique for prediction of highly complex and nonlinear systems like chaos. ANNs belong to the black box time series models and offer a relatively flexible and quick way of modeling. These models can treat the non-linearity of system to some extent due to their parallel architecture.

Hsieh(1990) has written in his technical report that After the stock market crash of October 19, 1987, interest in nonlinear dynamics, especially deterministic chaotic dynamics, has increased in both the financial press and the academic literature. A popular one is that the stock market is governed by chaotic dynamics. Chakraborty *et al*.(1990) presents a neural network approach to multivariate time-series analysis. Our method is not problem-specific, and can be applied to other problems in the fields of dynamical system modeling, recognition, prediction and control.

In ANNs, the work by Chakraborty *et al*. (1992), demonstrates efficient tools for prediction in hydrology, as black-box (i.e. time series) models. ANNs are supposed to posses the capability to reproduce the unidentified relationship existing between a set of input variables as rainfall and single or more output variables as runoff of the system. Grayson *et al*. (1992), have described that many of the deterministic medical data diagnosis need a large amount of data for training and testing purposes, and these are computationally expensive. As a result, the utilization of deterministic models of the medical data diagnosis process is viewed rather sceptically by researchers and consequently has not become very popular. In ANNs, the work by French *et al*. (1992), demonstrates the potential of ANNs in handling the complex processes of the time evolution of rainfall.

Kember *et al*.(1993), have tried to do nearest neighbor method (NNM), the NNM model is found to improve forecasts as compared to auto-regressive integrated moving average which is known as ARIMA models . Hammerstrom (1993), has explained that ANNs outstanding performance as regression tools, mainly when used for pattern recognition and function estimation. They are extremely nonlinear and capable to capture complex interactions along with the input variables in a system without any previous knowledge about the nature of these interactions.

Connor *et al*.,(1994) have discussed a robust learning algorithm and apply it to recurrent neural networks. This algorithm is based on filtering outliers from the data and then estimating parameters from the filtered data. The filtering removes outliers from both the target function and the inputs of the neural network .Zhu *et al*. (1994), have used ANN technique to predicted upper and lower bounds lying on the flood hydrograph in Butter Creek, New York. Mitchell (1995) "Knowledge discovery" is one of the most recent and fastest growing fields of research in computer science. It combines techniques from machine learning and database technology to find and extract meaningful knowledge from large, real world databases. Much real world data is temporal in nature, for example stock prices, dairy cow milk production figures or meteorological data. Chandonia & Karplus (1994) A pair of neural network-based algorithms is presented for predicting the tertiary structural class and the secondary structure of proteins. Each algorithm realizes improvements in accuracy based on information provided by the other. Hsu *et al*. (1995), presented a method called Linear Least Squares Simplex (LLSSIM), It is identifying the structure and parameters of a three layer feed-forward ANN (FFNN), which involved multiple random starts in weight space and consequently reduced the probability of finding local minima.

Machado(1996) has written in his technical report that neural networks have been applied to medical problems in recent years, their applicability has been limited for a variety of reasons One of those barriers has been the problem of recognizing rare categories. Zhang *et al*.(1997) have found that the current state of the use of ANNss for forecasting application. The Sole of ANNs – adaptability, nonlinearity, arbitrary function mapping ability – make them quite suitable and useful for forecasting tasks. Overall, ANNs give satisfactory performance in forecasting. Minns and Hall (1996), have concluded that the most of the work in ANN field for flood forecasting has been mainly theoretical, focussing on neural network performance with artificially generated Medical data. Zhang *et al*.(1997) have found that the current state of the use of ANNs for forecasting application. The unique characteristics of ANNs – adaptability, nonlinearity, arbitrary function mapping ability – make them quite suitable and useful for forecasting tasks. Overall, ANNs give satisfactory performance in forecasting. Shamseldin (1997), presented the conjugate gradient technique to train the network using data from six catchments area from different type of climates and ANNs demonstrated a better performance compared with other models.

In a preliminary study Albers *et al*.(1998) have discussed Neural networks are dense in the space of dynamical systems. Papik *et al*.(1998)concluded that neural networks have not broken through many of the barriers to applied sciences. This technique was been applied only for testing mathematical models developed for simple problem solution in practice. During the growth of ANN concept, Dibike and Solomatine (1999), have investigated two types of ANN architectures namely MLP network with back propagation algorithm(BPN)

and radial basis function network (RBFN) and found that ANN-based forecast model is better than conceptual model.

Mahfouf *et al*.(2000) have discusses that the 1980s new techniques have appeared from which fuzzy logic has been applied extensively in medical systems. Yao & Tan (2000) have discussed that a neural network model is applicable to the prediction of foreign exchange rates. Hayashi *et al*.(2000) have found that Neural networks have been widely used as tools for prediction in medicine. In this technical reports the results from two neural network rule extraction techniques, NeuroLinear and NeuroRule applied to the diagnosis of hepatobiliary disorders. Zhang and Govindaraju (2000), have analyzed that the Medical Data modelling is a complex, dynamic, and non-linear process, which is affected by many and frequently interrelated, physical factors. In the context of hybrid modelling, Toth *et al*.(2000), have analyzed and compare the relative advantages and restriction of linear stochastic auto-regressive moving average (ARMA) based models, ANN and the non-parametric nearest-neighbours method based model It is found that these models are useful for predicting Medical Data.

In the year of 2001 Crook & Scheper (2001)have found deterministic chaos is a powerful mechanism for the storage and retrieval of information in the dynamics of ANNs. Substantial evidence has been found in biological studies for the presence of chaos in the dynamics of natural neuronal systems. Potapov & Ali (2001) have found that embodied neural networks are a new and interesting ¯eld of studies from the viewpoint of nonlinear dynamics. The only problem is that one needs a controlled system to study an embodied network. Chaotic systems such as logistic map, Lorenz system, and Henon map have helped formulate most of the concepts of contemporary nonlinear dynamics. Zhang (2001) have describe that ARIMA model has become one of the most popular methods in the forecasting research and practice. More recently, ANNss have shown their promise in time series forecasting applications with their nonlinear modeling capability. Zhang & Berardi (2001) have found the use of neural network combining methods to improve time series forecasting performance of the traditional single keep-the-best (KTB) model. Chang, *et al*.(2001), applied and modify RBF neural network (NN) in that case the customized RBFN has capability of providing randomly good prediction of flood flow up to three hours ahead.

Allende *et al*.(2002) have discussed that the learning methods in ANN are sophisticated statistical procedures and that tools developed for the study of statistical procedures generally do not only yield useful insights into the properties of specific learning procedures but also suggest valuable improvements in alternatives to and generalizations of existing learning procedures. The advantage of the ANN technique proposed in this paper is that it provides a methodology for model-free approximation; i. e. the weighted vector estimation is independent of any model. Brath *et al*.(2002) have describe that Time-series analysis techniques for improving the real-time flood forecasts issued by a deterministic lumped rainfall-runoff model are presented. Lisboa(2002) has discusses that assess the evidence of healthcare benefits involving the application of ANNss to the clinical functions of diagnosis, prognosis and survival analysis, in the medical domains of oncology, critical care and cardiovascular medicine. Tseng *et al*. (2002) combined the seasonal ARIMA model and the BPN model to forecast seasonal time series data with seasonality and found that the SARIMABP model outperforms the SARIMA model and the BPN model. Randall and Tagliarini (2002), have used FFNNs technique and compare with ARMA techniques. It was found that FFNNs technique provides better forecasting results rather than ARMA technique.

In the significant contributions in 2003,Slomatine and Dulal (2003), have used ANNs and model trees (MTs) technique and found that both techniques have approximately similar performance for 1 h ahead prediction of Dignosis, but the result of the ANN is a slightly better than the MT for higher lead times. Mahabir *et al*. (2003), have applied fuzzy logic modelling techniques and this technique provides more accurate quantitative forecast. Gaume and Gosset, (2003), have employed FFNN which is appeared to be better forecasting tools than linear models. The FFNN model can be efficient simply if those functions are appropriate for the process to be simulated.

Kamruzzaman *et al*.(2004) have discusses that the modified feed forward neural network constructive algorithm (MFNNCA), a new algorithm for medical diagnosis.; the approach for the incremental construction of near-minimal neural network architectures for pattern classification are the new constructive algorithm with back propagation. Obenshain(2004) has written in his technical report that Automated surveillance systems offer obvious advantages over manual ones. When analytical technologies are embedded in automated hospital infection surveillance systems, it is not clear whether data mining outperforms traditional statistical methods. Rivas *et al*.(2004) This paper is focused on determining the parameters of radial basis function neural networks (number of neurons, and their respective centers and radii) automatically. Hulthen (2004) has discussed that it is possible to obtain better forecasts with an RNN than with an FFNN, but that the improvements are generally small. Agarwal and Singh (2004), have developed the BPN model with the data having comparatively high variability and uncertainty learned in fewer number of iterations including high generalization. The Performance of BPN model is compared with advanced linear transfer function (LTF) model and found that BPN model is better.

The important contributions in 2005 Kokkinos (2005) has found that the nonlinear models of the speech production system are constructed on the reconstructed attractor of speech signals. These models have been used for the extraction of features that can help with the characterization of chaotic systems, namely Lyapunov Exponents. Yoo *et al*.(2005)have discussed The SRWNN, which is a new network structure, based predictive control method has been proposed for chaotic systems. Pan *et al*.(2005) have discussed that the architecture perspective, a FNT can be seen as a flexible multi-layer feed forward neural network with over-layer connections and free parameters in activation functions. Nayak *et al*.(2005), have used fuzzy computing approach and have provided quick prediction based only on forecast values and improved the forecasts at greater lead times. Ghedira *et al*.(2006), have used ANN system and concluded that the performance of neural network reaches 82 % and 10 % greater than the filtering

algorithm in favour of the test data sets which is not used in the neural network training process.Liu *et al*.(2006), have studied transfer function noise (TFN) in the perspective of time series, the grey system (GM), with the adaptive network-based fuzzy inference system (ANFIS) ,found that performance of ANFIS is better. Li, *et al*., have applied Fuzzy neural network and this model increased the network ability to model complicate nonlinear problems such as runoff forecast. Khan and See (2006), have studied one statistical and three Data-driven modelling (DDM) approaches and found that DDM is better than Statistical approach.

Wasan *et al*(2006) have discusses that Data mining technology provides a user-oriented approach to novel and hidden patterns in the data. Data mining and statistics both strive towards discovering patterns and structures in data. Statistics deals with heterogeneous numbers only, whereas data mining deals with heterogeneous fields. We recognize a few area of healthcare where these techniques can be useful to healthcare databases for knowledge discovery. Lisboa *et al*.(2006) have discussed that clinical trials of neural network systems identified trends in areas of clinical promise, specifically in the diagnosis, prognosis and therapeutic guidance for cancer, but also the need for more extensive application of rigorous methodologies. Crone *et al*.(2006) have discussed that novel algorithms of Support Vector Regression and Neural Networks have received increasing attention in time series prediction.

Moreover, In the significance contributions in 2007,Gil(2007) has written A model combining recurrent and feed forward network to predict chaotic time series, called the hybrid complex neural network, using a HCNN for prediction of electrocardiograms are not satisfactory yet, However, HCNN is able to oscillate in a bounded and autonomous way, and generates a signal with positive LE. Drăgulescu & Albu(2007) have found evidence some important aspects connected to medical decision making. Therefore, the system presented here is made from three important parts.

Cheng *et al*.(2007), have projected Bayesian forecasting system (BFS) framework along with BPN and this techniques not only increases forecasting accuracy greatly but also present more information for flood control. Jiang *et al*.(2007), have introduced Fletcher-Reeves algorithm in BPN model and found that this model can improve the convergence rate without increasing its complexity, consequently the forecasting accuracy of the BPN model is improved. Broersen (2007), has introduced ARMA time series models and its performed well for small samples. Sallehuddin *et al*.(2007) proposed a approach called generalized regression neural network (GRNN) and ARIMA, which is hybridizing linear ARIMA and nonlinear GRNN models and concluded that GRNN- ARIMA can be applied as an alternative technique for forecasting time series data for better prediction accurateness. Moore (2007), has developed Probability distributed model(PDM) and PDM is used for real time forecasting.

Bertsimas *et al*.(2008) have discusses that modern data-mining methods provide quantifiable predictions of medical costs and represent a powerful tool for the prediction of healthcare costs. Researchers (Kaltech 2008), have also examined the performance of developed ANN models with previous methods (Neural Interpretation Diagram, Garson's algorithm, and randomization approach) effectively and demonstrated their approach to understand the relationship learned by the ANN model. Li and Yuan (2008), have developed data mining tools with BPN. This approach needs less input data requisite, not as much of maintenance and performs easy forecasting process and Good precision of forecasting. Liu *et al*.,(2008), have proposed nonlinear forecast modeling based on wavelet analysis. It is effective method and is able to provide good accuracy, efficiency and satisfying forecast results in the different time scales. Sun *et al*(2008), BPN model with space reconstruction theory and the result shows that the model has a very good forecast accuracy and value. Liu *et al*.(2008), have utilized the concept of adaptive network based fuzzy inference system (ANFIS) and concluded that ANFIS was better than ARMA Model. Aytek.*et al*.(2008), have compared two technique of ANN (i) BPN and (ii) GRNN methods with one evolutionary computation (EC) method and found that ANN has better potential. Pei and Zhu (2008), have applied fuzzy inference technique and the results specify that the model can efficiently identified the forecast factors subsequently the forecast precision is improved.

Patel *et al*.(2009) have discusses that the discussants reflect on medical AI research during the subsequent years and characterize the maturity and influence that has been achieved to date. Awad *et al*.(2009) have deal with the problem of time series prediction from a given set of input/output data. This problem consists of the prediction of future values based on past and/or present data. Morariu *et al* (2009) have presents some aspects regarding the use of pattern recognition techniques and neural networks for the activity evolution diagnostication and prediction by means of a set of indicators. Gheyas & Leslie (2009) have proposed algorithm which is an ensemble learning technique that combines the advice from several Generalized Regression Neural Networks. Singh & Chauhan (2009) have describe that the neural networks to be a promising data mining tool. ANNs offer qualitative methods for business and economic systems that traditional quantitative tools in statistics and econometrics cannot quantify due to the complexity in translating the systems into precise mathematical functions. Kulkarni & Venayagamoorthy(2009) have discussed that the Generalized Neuron(GN)and recurrent GN (RGN) can perform good classification, nonlinear function approximation, density estimation and chaotic time series prediction. Ping (2009), has combined technique of BPN and Wavelet neural network(WNN) .This combine technique solving the dynamic time series problem which is specifically shows feasibility and effectiveness of the technique. In the case study Zhu *et al*.(2009). have applied Wavel*et Al*gorithm and found that Forecast precision is improved. Yan *et al*.(2009), have proposed RBF model and compared the results with the field data consequently the forecasting error is analyzed as well as the model improves the forecast accuracy. Sihui (2009), has developed single element medium and long-term classification forecast model. The result indicates that the forecast model can describe the relationship between forecast factors and forecast object efficiently as well as accurately, after that model is become more credible. Hung *et al*.(2009), have utilized BPN technique and found that the superiority in performance of the BPN model over the persistent model. Furthermore the

accuracy and efficiency of forecast has been improved by ANN.

In the year of 2010, Aamodt (2010) has investigates the application of ANNs for forecasting financial time series (e.g. stock prices). Peralta *et al*.(2010) have discussed Accurate time series forecasting are important for displaying the manner in which the past continues to affect the future and for planning our day to-day activities. Kock & Teräsvirta(2010) have written in this technical report, nonlinear models are restricted to mean nonlinear parametric models. Several such models popular in time series econo-metrics are presented and some of their properties discussed. Paoli *et al*.(2010) have present an application of ANNs in the renewable energy domain. Srinivas *et al*.(2010) have discusses that the potential use of classification based data mining techniques such as Rule based, Decision tree, Naïve Bayes and Artificial Neural Network to massive volume of healthcare data. Camplani(2010) has written in his technical report that The time series data can be embedded in phase space of different dimension while preserving the attractor behavior. Moreover, the variable chosen as observable strongly influences the accuracy of the forecasting of nonlinear dynamics. Ganesan *et al*.(2010) have discusses that how neural networks are used in actual clinical diagnosis of lung cancer. Birinci and Akay (2010) compared the performance of the RBFN model with MLR and ARIMA models for daily mean flow prediction .It is found that the RBFN model is better than other two models for long term continuous data.

Gil *et al*.(2011) have discussed The accuracy of a model to forecast a time series diminishes as the prediction horizon increases, in particular when the prediction is carried out recursively. Such decay is faster when the model is built using data generated by highly dynamic or chaotic systems. Adhikari & Agrawal (2011) in this technical report Enhancing the robustness and accuracy of time series forecasting models is an active area of research. Recently, ANNs have found extensive applications in many practical forecasting problems. During the growth of ANN concept Moreno *et al*.(2011) have witten in this technical report the description and comparison of the main models of Artificial Neural Networks (ANN) which have proved to be useful in time series forecasting, and also a standard procedure for the practical application of ANN. Wagner(2011) this technical report describe a real-world system developed for a large food distribution company which requires forecasting demand for thousands of products across multiple warehouses. Ilker *et al*. (2011), have applied BPN along with coefficient of determination (R2) with root mean square error (RMSE) furthermore found that the performance of the best model using BPN technique. The model was developed by Ghumman *et al*.(2011), to suite the conditions in which the collected dataset is not sufficient and the quality of dataset is doubtful .The results explained that ANN model is an major different of conceptual models and it can be utilized when the series of collected dataset is short and data is of low standard. Chen, *et al*.(2011), have improved GIS-based TOPMODEL and found that the Improved TOPMODEL can be used for forecasting operations.

In the development of Medical Data Model, MLPs are the simplest and generally used neural network architectures. It can be trained using many different learning algorithms. Dalkiran & Danisman(2011) have written in this technical report a feed-forward Multi Layer Perceptron (MLP), trained with Bayesian Regulation back propagation algorithm, was found as the suitable network structure. Akintola *et al*.(2011) According to this technical report need more data to train the network to be able to give a better prediction and The application of neural network in forecasting stock prices is studied. Afshar*et al*(2011) have describe that the Leukemia is one of the most common cancers in children, comprising more than a third of all childhood cancers[99]. Andrawis *et al*.(2011) in this technical report it presented the model with which we participated in the NN5 time series competition. Pacelli *et al*.(2011) this technical report show that The good forecasting performance of the network developed and the process of formation of rate ex-change is not completely governed by noise. Bunnoon (2011) accourding to this technical report two and three years ahead for the load forecasting by using differential models and a varies number of a neuron in the hidden layer for finding the minimum MAPE of each model. Li & Chong-xin (2011) have discussed that Improved back propagation BP algorithm based on genetic algorithm GA is used to train and forecast. This technical report uses the load data of Shaanxi province power grid of China to complete the short-term load forecasting. The results show that the model in this paper is more effective than classical standard BP neural network model. Borade & Bansod (2011) According to to this report it study in which forecasts were made using non-traditional forecasting methods. Various supply chain cost elements were considered for analysis. A comparison was made using multi-criteria decision-making tools. Kadhim (2011) has written in his technical report that The ANNs methodology to distinguish between healthy and unhealthy person based upon selected symptoms showed very good abilities of the network to learn the patterns corresponding to symptoms of the person. The network was simulated in the testing set (i.e. cases the network has not seen before). The results were very good; the network was able to classify 99% of the cases in the testing set. Anto & Chandramathi (2011) have found the main objective of this survey is to analyze the most imperative machine learning techniques and suggest the best suitable technique for medical data set classification. But, it cannot be concluded that one algorithm is always superior to other. Fu(2011) in this discussion a comprehensive revision on the existing time series data mining research is given.

Dumitru(2012) has discussed the sensitive dependence on initial conditions (SDIC), feature to chaotic systems, the prediction of such system can be made with an accepted accuracy only for relatively small number of steps ahead. Using artificial techniques like neural networks and support vector machine to predict chaotic dynamics present advantages over traditional methods and usually they offers superior results. Esling & Agon(2012) have discussed in incredible diversity of fields ranging from economy, medical surveillance, climate forecasting to biology, hydrology, genetics, or musical querying the Time-series data mining techniques are currently applied. Tan *et al*.(2012) this technical report shows Evaluation on the proposed KGA model on the Mackey- Glass time series reveals that the proposed KGA model is able to find the optimal number of neurons in the hidden layer of the BP network. Yeh & Chang (2012) this technical report applies both the neural network and adaptive neuro-fuzzy inference system

for forecasting short-term chaotic traffic volumes and compares the results. Abounoori *et al*.(2012) have found the dynamic neural network autoregressive model and also static fuzzy neural network models (ANFIS) and multi-layer feed-forward neural network model (MFNN) were used for forecasting the return of Tehran Stock Exchange index.and ANFIS model has made a more accurate forecast of stock return series. The result is NNARX and MFNN had a better performance in forecasting this variable respectively. Milovic(2012) has written in his technical report that Data mining has great importance for area of medicine, and it represents comprehensive process that demands thorough understanding of needs of the healthcare organizations. Mittal *et al*.(2012),have developed a double (combined and paralleled) artificial neural network (D-ANN) and concluded that the performance of D-ANN model better than the feed-forward ANN model Jingwen *et al*.(2012), have used XXT model (where the first X stands for Xinanjiang, the second X stands for hybrid, and T stands for TOPMODEL) and found that the results show that XXT has better performance against the TOPMODEL and the Xinanjiang model.

In the year of 2013 Li *et al*.,(2013) have discussed The prediction of chaotic time series is an important research issue. To improve the prediction accuracy, a hybrid approach called WNN-PSO is proposed, which based on the self-learning ability of wavelet neural network, whose parameters are optimized by particle swarm optimization. Tongal (2013) has discussed Hydrological systems are complex and dynamic in nature as their current and future states depend on numerous variables (Tongal *et al*., 2013). Therefore, it is important to determine the number of dominant variables acting within the system dynamics. In regards to this, the methods from chaos theory provided us a proper framework. Samek & Varacha (2013) In this technical paper it shows the case study of artificial time series prediction using various artificial neural network structures. There has been tested prediction of non-artificial data from the Santa Fe benchmark. The presented simulations showed dependencies of prediction accuracy on the number of values in input vector. Nanda *et al*(2013) have describe that for prediction of time series data the ARIMA(1,1,1) model and Artificial Neural Network (ANN) models like Multi Layer Perceptron (MLP), Functional-link Artificial Neural Network (FLANN) and Legendre Polynomial Equation (LPE) were used.it was found that FLANN gives better prediction results as compared to ARIMA model with less Absolute Average Percentage Error (AAPE) for the measured rainfall data. Peyghami & Khanduzi (2013) have found a new global and fast Multilayer Perceptron Neural Network (MLP-NN) which can be used to forecast the automotive price. Aljumah *et al*.(2013) have discusses that the elderly diabetes patients should be given an assessment and a treatment plan that is suited to their needs and lifestyles. Durairaj & Ranjani (2013) have found The prediction of diseases using Data Mining applications is a difficult task but it drastically reduces the human effort and increases the diagnostic accuracy. Elalfi *et al*(2013) have discusses that approach based on image processing and neural network technology using feed forward neural network trained by the error back-propagation algorithm that allowed its use to classify heart valve diseases is proposed. Nithya *et al*.,(2013) have discussed that Selection of data and methods for clustering is an important task in medical diagnosis and needs the knowledge of the domain. Oguntimilehin *et al*.(2013) have discussed that A new approach to the diagnosis of typhoid fever using a machine learning technique was developed and the performance of the system was measured on both the training set and testing set. Ramana *et al*.(2013),have combined the wavelet approach with ANN technique and found that the performances of wavelet neural network models are more effective than the ANN models in some extent.

Zhang(2014) has found the multiple-sections traffic flow forecasting method in road network based on multi-dimensional chaotic time series prediction is feasible, and the predictive effect is better than of the single-section chaotic time series prediction method. Batista *et al*.(2014) have discussed that The ANN technique used a multidisciplinary cooperation—involving the fields of neuroscience, mathematics, computer science, and statistics— being applied to various problems in different areas, including medicine. Its ability in recognizing patterns is widely applied in image recognition, spectral analysis, decision making in complex problems—linear and non linear-among other subjects. Arabgol & Ko(2014) have found developing a model to predict the amount of healthcare waste. For this purpose, three models based on artificial neural network (ANN), multiple linear regression (MLR), and combination of ANN and genetic algorithm (ANN-GA) are applied to predict the waste of 50 hospitals in Iran. Result shows that GA has significant impact on optimizing initial weights and improving the performance of ANN. Liu *et al*.(2014) in this technical report the time series model, Seasonal Autoregressive Integrated Moving Average with exogenous variables (SARIMAX) scheme was proposed. Su *et al*.(2014) this report present a novel local nonlinear model called local polynomial coefficient autoregressive prediction (LPP) model based on the phase space reconstruction. The LPP model can effectively fit nonlinear characteristics of chaotic time series with simple structure and have excellent one-step forecasting performance and also proposed a kernel LPP (KLPP) model which applies the kernel technique for the LPP model to obtain better multistep forecasting performance. Rivero & Pucheta (2014) this literature review present forecasting rainfall time-series with stochastic output approximated by neural networks Bayesian approach.

Sreekumar & Badjate(2015) have found that the various modeling techniques in soft computing for various weather applications in Presence of chaos if any. Martínez-Álvarez *et al*.,(2015)have found the application of time series forecasting. Kleist(2015) According to this technical report real world time series data sets can take a size up to a trillion observations and even more. Data miners' task is it to detect new information that is hidden in this massive amount of data. Awwalu (2015) have discussed that The implementation of Personalized Medicine heavily relies on AI algorithms. Lucia *et al*(2015) have discussed that the analysis of NARX neural network against standard ARIMA models. Kaur *et al*(2015) have discussed that the Data mining really provide an efficient way to extract the required clinical information from voluminous, raw and heterogeneous data.

Jain(2015) have present that Successful implementation of machine learning algorithms in medical diagnosis can help the integration of computer based systems in the healthcare environment. Olaniyi & Oyedotun (2015) have found that support vector machine is the best network for the diagnosis of heart disease. Ahmad *et al*.(2015) have discussed that To achieve medical data of higher quality all the necessary steps must be taken in order to build the better medical information systems which provides accurate information regarding to patients medical history rather than the information regarding to their billing invoices. Mustafa *et al*. (2015), have concluded that an appropriate training based ANN model is able to adopt the physical understanding between the variables that may be generated more efficient outcomes than conventional prediction techniques.

Raval *et al*.(2016) have discussed that the issue of current medical diagnosis system and used for the medical prediction Disease is one of the critical task while designing medical diagnosis software. Lipton *et al*.(2016) have discussed that Clinical medical data, especially in the intensive care unit (ICU), consist of multivariate time series of observations. Kavya & Arumugam(2016) have discussed in The data mining its main process is to collect, extract and store the valuable information and now-a-days it's done by many enterprises actively. In advanced analytics, Predictive analytics is the one of the branch which is mainly used to make predictions about future events which are unknown. Patel & Patel(2016) have found that some data mining techniques that has been employed for medical data. Parveen *et al*., (2016) have discussed that employing ANNs techniques in medical science can improve to diagnose in an intelligent way such as to develop the drugs prescription, recordkeeping of patients by maintaining the patient's history so it can be easy to analyze the prediction of diseases. Canedo *et al*.,(2016) have discussed that the use of machine learning techniques in the clinical eld constitutes a crucial step in a growing trend towards more personalized, predictive medicine. At a more fundamental level, it is also evident that machine learning can also help to get better our basic understanding of the mechanisms under the development of several sickness and disorders. Sharma *et al*(2016) have discussed architecture of neural network like back-propagation, redial basis function, multi layer perception recurrence neural network are found suitable sufficient for prediction over 17 different applications and the result obtained the neural network is significant in prediction of non-linear dynamic system. Al-Maqaleh *et al*.(2016) have discussed that ANNs gives better predictive values due to their ability to deal with the nonlinear and stochastic data better than traditional statistical modeling techniques. Karmakar *et al*.(2016) have found that Neural Network such as BPN, RBF is best appropriate to be predicted chaotic behavior of climate variables like rainfall, rainfall runoff, and have efficient enough for prediction in long period. It is also found that Neural Network is significant for spatial interpolation of mean climate variables. Kuna(2016) has found the Machine learning algorithms are used to analyse and create models of the data. Patterns found in the data structure are then exploited to make predictions about the future which can be used to guide decision making. Jha *et al*. have found the Modelling of growth trend and improvement in forecasting techniques for vehicular population has always been and will continue to be of paramount importance for any major infrastructure development initiatives in the transportation engineering sector. Chaudhuri *et al*(2016) this technical report that, although the two different approaches are quite efficient in forecasting the exchange rate, MLFNN and NARX are the most efficient. Riemer *et al*.(2016) this technical report introduces a novel neural network attention mechanism that naturally incorporates data from multiple external sources without the feature engineering needed to get other techniques to work.

At the end of this review following methods are identified in suitability of diagnosis of medical data as shown in Table 1. Wherein, image processing, satellite data analysis, numerical, and dynamic equation based modeling have been found. As far concern of numerical modelling through past recorded data the statistical based, support vector machine and ANN are better option. However, the numerical modeling through ANNs and fuzzy logic are found better evaluated over the other conceptual and numerical methods. In the next section, the performances of ANN methods those are significantly used in diagnosis of medical data are discussed.

Table 1 Identified methods of diagnosis of medical data in the literature (1972-2016)

No.	Year	Methods	Contributor(s)
1	1972	Chaotic Theory (Behaviour)	Lorenz
2	1986	Black-Box (i.e. Time Series) Models	Rumelhart *et al*.,
3	1990	Chaotic Theory	Hsieh
4	1992	Black-Box (i.e. Time Series) Models	Chakraborty *et al*.
5	1992	Artificial Neural Networks –ANN	French *et al*.
6	1993	Nearest Neighbor Model(NNM)-ARIMA Model	Kember *et al*.
7	1993	Artificial Neural Networks –ANN	Hammerstrom
8	1994	Recurrent Neural Networks (RNNs)	Connor *et al*.
9	1994	Artificial Neural Networks –ANN	Zhu *et al*.
10	1995	Time-Series Analysis Techniques	Mitchell
11	1994	Neural Network-Based Algorithms	Chandonia & Karplus
12	1996	Sequential Neural Network Model	Machado
13	1997	Artificial Neural Networks –ANN	Zhang *et al*.
14	1998	Time Series Analysis	Albers *et al*.
15	2000	Fuzzy logic; Fuzzy control;	Mahfouf *et al*.
16	2000	Time Series Technique	Yao & Tan
17	2000	Neural Networks	Hayashi *et al*.
18	2001	Chaotic Neural Networks	Crook & Scheper
19	2001	Artificial Neural Networks & Hamiltonian Neural Networks	Potapov & Ali
20	2001	Time Series Analysis Technique, ARIMA Model	Zhang
21	2002	Time Series Analysis Technique	Breath *et al*.
22	2002	Artificial Neural Networks –ANN	Allende *et al*.
23	2002	Artificial Neural Networks –ANN	Lisboa
24	2004	Back Propagation Network-BPN	Kamruzzaman *et al*.
25	2004	Radial Basis Function Neural Networks(RBF NN)	Rivas *et al*.
25	2004	Feedforward Neural Networks (FFNNs) & Recurrent Neural Networks (RNNs)	Hulthen
26	2005	Fuzzy-logic Systems, Support Vector Machines	Kokkinos
27	2005	Self-Recurrent Wavelet Neural Network (SRWNN)	Yoo *et al*.
28	2005	Genetic Algorithm (GA) and Steepest Descent Method (SDM	Pan *et al*.
29	2006	Predictive Models	Wasan *et al*.
30	2006	Artificial Neural Network (ANN)	Lisboa & Taktak
31	2006	Support Vector Regression	Crone *et al*.
32	2007	Feedforward Neural Networks (FFNNs) & Recurrent Neural Networks (RNNs),Hybrid Complex Neural Networks(HCNN)	Gil
33	2007	Artificial Neural Network (ANN)	Drăgulescu &Albu
34	2009	Time Series Analysis Technique	Award *et al*.
35	2009	Generalized Regression Neural Network	Gheyas &Leslie *et al*.
36	2009	Generalized Neural and Recurrent Neural Network	Kulkarni & Venayagamoorthy

37	2010	Time Series Analysis Technique	Peralta *et al*.
38	2010	Nonlinear Parametric Models	Kock &Terasvirta
39	2010	Artificial Neural Networks –ANN	Paoli *et al*.
40	2011	Time Series Analysis Technique	Gil *et al*.
41	2011	Time Series Analysis Technique & Artificial Neural Network	Adhikari & Agrawal
42	2011	Artificial Neural Networks –ANN	Moreno *et al*.
43	2011	Feedforward Multi Layer Perceptron(MLP)	Dalkiran & Danisman
44	2011	NN5 Time Series	Andrawis *et al*.
45	2011	Artificial Neural Network (ANN), Genetic Algorithm, and Fuzzy logic (Fs)	Bunnoon
46	2011	Back Propagation Network –BPN	Li & Chong-Xin
47	2012	Support Vector Machine -SVM	Dumitru
48	2012	Time Series Analysis Technique	Esling & Agon
49	2012	K-means-Greedy Algorithm (KGA) model	Tan *et al*.
50	2012	Polynomial Model, Neural Network-Based Black-Box Models, Adaptive Neuro-Fuzzy Inference System	Yeh & Chang
51	2012	Neural Network Autoregressive Model, Static Fuzzy Nural Network Model & Multi –layer Fedforward Neural Networks Model (FFNNs)	Abounoori *et al*.
52	2013	Chaotic Theory & Wavelet Neural Network-WNN	Li *et al*.
53	2013	Chaotic Theory	Tongal
54	2013	ARIMA Model, Artificial Neural Networks –ANN,Multi Layer Perceptron(MLP),Function-link Artificial Neural Network(FLANN) & Legendre Polynomial equation (LPE)	Nanda *et al*.
55	2013	Multi Layer Perceptron Neural Network(MLP-NN)	Peyghami &khanduzi
56	2013	Data Mining Application	Durairaj & Ranjani
57	2013	Fedforward Neural Networks & Back Propagation Network-BPN	Elalfi *et al*.
58	2014	Chaotic Time Series Analysis Technique	Zhang
59	2014	Artificial Neural Network (ANN),	Batista *et al*.
60	2014	Artificial Neural Network (ANN), Multiple linear Regression (MLR) & Combination of ANN and Genetic Algorithm(ANN-GA)	Arabgol & Ko
61	2014	Time Series Model	Lui *et al*.
62	2014	Local Polynomial Coefficient Autoregressive Prediction (LPP) & Kernel (KLPP)	Su *et al*.
63	2014	Time Series Model	River & Pucheta
64	2015	Soft Computing	Sreekumar & Badjate
65	2015	Time Series Model	Martinez-Alvarez *et al*.
66	2015	AI Algorithm	Awwalu
67	2015	NARX Neural Network, ARIMA Model	Lucia *et al*.
68	2016	Time Series Model	Lipton *et al*.
69	2016	Data Mining Technique	Kavya & Arumugam
70	2016	Data Mining Technique	Patel & Patel
71	2016	Artificial Neural Network (ANN), Radial Basis Function network - RBFN	Parveen *et al*.
72	2016	Back Propagation Network –BPN, Multi Layer Perception Recurrence Neural Network(MLP-NN)	Sharma *et al*.
73	2016	Back Propagation Network –BPN	Karmakar *et al*.
74	2016	MLFNN & NARX Neural Network	Chaudhuri *et al*.

RESULTS AND DISCUSSION

It is found that the accuracy is major constraint in medical field which fail with minor fluctuation. The suitability of neural network for medical data diagnosis has greatly improved the performance and result accuracy. More the accuracy better are the results. Day by day more research work is going to achieve results with high accuracy and less effort to save to save precious human life before the problem occurs. Here BPN Model is significant and considerable. The BPN has high accuracy and can be used to forecast medical data diagnosis. The various BPN model have been identified for diagnosis of medical data.

Authos K. shrinivas *et al* shows the result which clearly states that TAN (Tree Augmented Naïve Bayes) works efficiently for the comparison of set of general and regular things like vehicles, anneal (metallurgy) over ODANB (One Dependence Augmented Naïve Bayes Algorithms),Naïve Bayes.but for prediction of Heart disease Naïve Bayes observes better results. The automatic diagnosis of lung cancer is an important, real world medical problem. The Neural networks are used in actual clinical diagnosis of lung cancer. Neural Network model, a diagnostic system that perform at an accuracy level. The Neural Network can be effectively used for lung cancer diagnosis to help oncologists.

According to researcher in one study the data obtained from UCI machine learning repository in order to diagnosed diseases. The data is separated into inputs and targets. The targets for the Neural Network will be identified with 1's as infected and will be identified with 0's as non infected. In the diagnosis of acute nephritis disease. The percent correctly classified in the simulation sample by the feed forward back propagation network is 99 percent while in the diagnosis of heart disease the percent correctly classified in the simulation sample by the feed forward back propagation network is 95 percent.

Author D. Raval *et al* have discussed the issue of current medical diagnosis system and various data mining algorithms are used for medical prediction. For prediction swine flu, significantly 12 attributes are used and give priories using information gain and using hidden layer of Neural network. The data mining technique like SVM, Naïve Bayes, KNN on swine flu actual data are applied to get the optimal output.

Author R. Praveen *et al*, have discussed that computing based models are really effective to fine vector born Disease and artificial neural network provide good efficiency in diagnosis. Also Neural network is useful to check cancer, cardia vascular and diabetic patient.

Accourding to S. Kaur accuracies are applied on various diseases using different data mining techniques. Accuracy is then computed from the above formula to find the no. of affected cases with respect to values in given parameters. Commonly used techniques are Decision trees (Dtrees), Artificial Neural Network (ANN), Naïve Bayes (NB). The Comparison of these techniques used year wise on different disease is analyzed. Table 2 shows the comparison of various diseases on ANN. No such work is done in drug abusers.

Table 2 Accuracies Applied on Artificial Neural Networks

Disease Considered	Author of Publication	Year of Publication	Accuracy in ANN
Breast Cancer	Dursun Delen *et al*.	2005	91.21%
Heart	Andreeva, P	2006	82.77%
Breast Cancer	Bellaachia *et al*	2006	86.50%
Heart	Palaniappan, *et al*.	2007	93.54%
Heart	De Beule, *et al*.	2007	82.00%
Heart	Tantimongcolwata,*et al*.	2008	74.50%
Heart	Hara, *et al*.	2008	82.30%
Heart	Akhil jabbar *et al*	2012	82.00%
Heart	Abhishek Taneja	2013	93.83%
Liver	Syeda Farha Shazmeen *et al*	2013	67.59%
Kidney	K R Lakshmi *et al*.	2014	93.85%

Table 2 shows maximum accuracy of 93.85% of kidney. More diseases are coming to research to find the chance with high accuracy of prediction of risky diseases. Figure 1 shows the graph of accuracies with range of percentage to diseases.

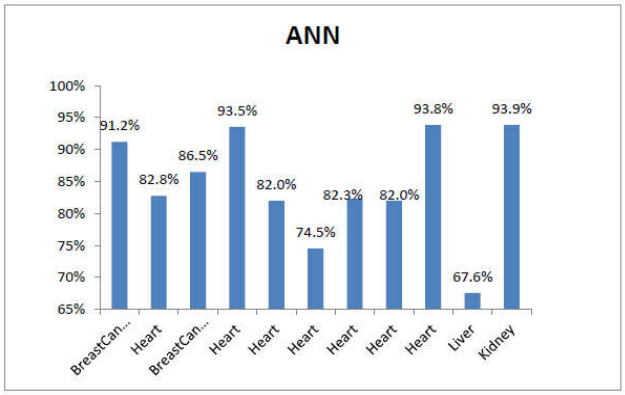

Figure 1. Comparison of Various Diseases on ANN Technique

ANN shows the maximum accuracy of 93.9% and minimum accuracy of 67.6%.

From the research it is also found that ANN is the best approach than numerical & traditional Methods. On the contry BPN is the best algorithm to use the neural network for medical data.

CONCLUSIONS

In this paper the issues of current medical diagnosis system and various techniques like Data Mining, Neural Network, Time Series analysis technique, used for the medical prediction have been explained. The focus is on using different algorithms and the consolidation of certain target attributes to predict diseases using these techniques.

An ANNs are broadly increasing and enabled in the field of medical science, as well as medical product and its application are involved from past history. Medical records are highly sensitive and contain a large amount of personal information. No doubt, traditional record keeping methods are also vulnerable regarding privacy and security, but remote access to a patient's data raises further risks of unauthorized entry into the data system. Thus employees connected with computerized data management system should be subjected to careful screening before employment. The creation of a proper audit trail by the database administrator will act as a deterrent to the misuse of medical information. Diagnosis of medical data is a complex and challenging task for a medical scientist. Though comprehensive study of various methods are used like ANN, Black box (time series) model, ARIMA model, black propagation model (BPN), recurrent neural network model (RNN), predictive model etc. in this survey two architecture of ANN such as BPN and RBF found suitable but BPN model has been compared with RBF, the BPN has high accuracy. So BPN system is sufficient enough for diagnosis of medical data.

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