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***Review Paper***

# Suitability of neural network for disease prediction: a comprehensive literature review

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## Abstract

*In this study, suitability and appropriateness of neural network for prediction of disease by past recorded data is identified from a comprehensive literature review. Wherein, research contributions from 1991 to 2016 are reviewed. It is found that different various architecture of Artificial Neural Network (ANN) such as Back-Propagation Network (BPN), Radial Basis Faction (RBF), Support Vector Machine (SVM), Multi Layer Perception (MLP), and Recurrence Neural Network (RNN) are found appropriate and sufficiently suitable. In recent years, these architectures are found suitable for prediction of more than 100 diseases. The discussions of these architectures and their suitability, appropriateness for disease prediction is presented through this review article.*

**Keywords:** Neural Network, Disease Prediction, Back-Propagation, Radial Basis Faction, Support Vector Machine, Recurrence Neural Network.

## Introduction

Most application of ANN are classified different problem that people has ANN System is defined as multilayered back propagation learning rule, its elements are, Number of input vector in input layer ($x_1$, $x_2$, $x_3$) Number of hidden layer, ($w_1$,$w_2$,$w_3$), Number of neurons (y) initial weights, learning rate, Number of output neurons (y), It can be handled as nonlinear dynamic System, where in different value of 'y' are dependent of independent variables .in other words we can say $x_1$,$x_2$,$x_3$ are forecaster of the system 'y' here 'y' is dynamic and on values on x1,x2,x3. Nural Networks and its training system algorithm are basically used to define such system by adjustment of weights $w_1$,$w_2$,$w_3$ during training process.

After training process each iteration the neural network may minimize the error between actual 'y's and its predicted value alteration of $w_1$,$w_2$,$w_3$ are called training process new rate of $x_1$,$x_2$,$x_3$ may workable be given predicated value of 'y' is testing .Science artificial Neural networks can Model the linear and Nonlinear framework in medical diagnosis. It have captivate moreover attention from theoretical searchers, enterprise, medical, weather, financial in recent years. Many supporters are utilizing neural network forecasts' of such system. We observed that the back propagation neural network is sufficient suitable for forecasts' of medical diagnosis. Thus in this study back progration neural network is applied for predication of different disease that people has with the help of symptoms.

Highly significant recent prediction afford have been found for dynamic system prediction during the period of 1991 to 2016 has been predict and classified yearly are given in this section as follows:

## Review of literature

Richard and Lippmann discussed classifiers estimate Bayesian a posteriori probabilities with ANN estimate is accurate. Squared error or cost–entropy cost functions is used and output to minimize alternative risk function[1].

Gori and Tesi found multilayered neural network back propagation algorithm conditions on network architecture, the result of paper learning environment allow BP to reach the optimal solution[2].

Sharpe et al. found potential benefit of ANN for the diagnosis of thyroid function. It examined two types of an architecture and Multilayer back–Propagation and learning vector quantization, of diagnostic noise and both architectures were efficient[3].

Shanker found artificial neural networks have been or alter native tool for classification. The lung capabilities of neural networks are compared to traditional method (logistic regression) which NNs can be used for Variable selection in Statistical Modeling[4].

Gatlly et al. discussed artificial neural networks prospective tools for analysis of psychiatric Disorders. Thus NN provide Model for brain activity that have been used a range of psychiatric disorders including schizophrenia, obsessive, compulsive disorder, posttraumatic stress disorder[5].

Kahn Jr. et al. discussed Bayesian network for mammographic diagnosis of breast cancer is a graphical representations of probabilistic Information. Each note of Graph represents breast cancer present and absent[6].

Human et al. discussed a brief review in kidney transplantation. These surgical techniques and preoperative care of patients combine with superior immune suppression, treatment of choice all of all ages with ESRD[7]. Zang et al. contributed a literature about ANN has powerful pattern classification and pattern recognition capabilities inspired by biological system[8]. In other application Schneider and Wrede found compute based molecular design. Neural Network for computer- aided molecular design and sequence analysis are discussed and compared to other application[9].

Zhang and Berardi, They discussed investigation of Neural Network in Thyroid Function diagnosis by ANN. The difficulty in diagnosis as pregnancy drug interactions, non thyroidal illnesses which problems measured in laboratory test[10]. Geddes et. al found an artificial neural network (Ann) to identify patients with IgA nephropathy More Accurately then experienced nephrologists with a poor prognosis and to compare the predictions of war trained and tested using a jack knife sampling technique[11].

Ludin et al. contributed artificial neural network applied to Survival Prediction in Breast Cancer. In this paper they evaluated the accuracy of neural network .and result shows NNs can be important tools for cancer Survival prediction[12]. Lek and Guegum discussed artificial neural networks or a tool in ecological modeling it introduce two algorithms frequently used one supervised network back propagation modeling second self organizing mapping algorithm[13].

Atienza et al. afford a description and comparison of accurate risk stratification of heart failure in patients. They identified relevant predictors using the Automatic Relevance Determination (AKD) method[14]. Govindaraju, contributed artificial neural networks in Hydrology. One of the most useful and interesting facto of ANN is nonlinear hydrologic processer such or rainfall runoff, stream flow, ground water management water quality simulation and precipitation[15]. Robert et al. discussed that the EEC a highly complex signal is most common sources used to brain study function, Artificial neural network implementer to understand up to date for EEG processing[16].

P.J.G. Lisboa Contributed a review of evidence of health In Medical intervention. Clinical functions of diagnosis prognosis and survival analysis in medical[17]. Zhou et al. presented an application of lung cancer cell identification based on artificial neural network ensemble. In this paper it introduced automatic pathological diagnosis procedure named neural Ensemble Based Detection (EBD) that has five different output demo carcinoma, squamours, all carcinoma, small cell, caronoma, large cell carcinoma and normal among as out it former four different helper of find cancer cells[18]. Rajimehr et al. introduced new methods such as Artificial Neural Network and Regression Models have been proposed to improve the performance of physician and surgeons in risk stratify of their patients[19].

Papaloukas et al. discussed on ischemia detection method based on Artificial Neural Networks. That depends on long duration electrocardiographic (ECG) recording was evaluated on ESC ST-T database[20]. Ciampi and Zhang presented a new approach of Artificial Neural, Nets BP- ANN based on regularization and Cross – validation on initialization by logistic regression (LR) model and evaluation criteria used (C-index, MSF and error rate)[21].

Chang et al. discussed improvement in breast Tumor Decimation by support vectors machines and speckle emphasis texture analysis. It proposed a high precision computer aided diagnosis (C.A.D) system for sonography[22]. Acharya and Lyengar applied Neural Network classification of heart rate data using and fuzzy equivalence relation. In this paper they presented of heart rate variability (HRV) as base signal for analysis and classification. Heart rate is evaluated by measuring the time internal between the successive R- peaks (R-R interval) of ECG wave form[23]. Zitar presented Neural Network model for insulin/glucose in diabetics. NN"s model resembles the interaction between glucose concentration levels and amount of insulin injected in bodies it compared Levenberg Marquardt (LM) training multilayer feed forward and radial basis NN function. That the actual output LM, NN better model then other application[24].

Taylor et al. discussed about verification and validation of neural networks other tradition non-deterministic result, safety and mission critical system. Verifying correct operation of neural network NN with NASA projects[25]. Hsia et al. discussed on prediction of survival in surgical unrespectable lung cancer including genetic polymorphism and clinical parameters[26].

Abdolmaleki et al. designed an algorithm model based on the logistic regression and a non algorithm model based on the ANN these model compared together in clinical application to differentiate malignant from benign breast tumors and ANN and LRM. Prove relationship between extracted morphological features and biopsy relation[27].

Artificial neural network had been used by Kerkeni et al. in neuronal spectral Analysis of EEG and interpreted signal coming from electroencephalogram (EEG) in this paper the formwork of asleep analysis study it shown EEG signal can be early recorded and analysis can lead to identify recognize such elements as vigilance staler pathologies of sleep[28]. Pedrajas discussed in his paper Pattern Classification approach for designing neural network ensemble. cooperative convolution is a recent paradigm in evolutionary computation that show effective modeling of cooperative environment ANN is powerful tools for facing complex problem[29].

Ferrero et al. offered a description is to present an experimental application for the detection of detection of possible breast lesions by means of neural networks in medical digital imaging[30]. Bassi et al. offered a description and comparison of the prognostic performance of artificial neural networks (and) with standard logistic regression (LR) in patients undergoing radical bisector for bladder cancer[31]. Antkowiak discussed in his thesis submitted to UMEA university that Artificial Neural Network Vs support vector Machines for skin disease Recognition system for recognition of skin disease (skin checker) using ANN and SVM[32]. Sawar Kar et al. have found neural networks support vector machine method for diagnosis of breast cancer. SVM is implemented using the kernel adaption algorithm thus substantially reducing the number of unnecessary surgical procedure[33].

Pappada et al. found Neural Network for prediction of glucose concentration in diabetes patients such as insulin dosage nutritional intake daily activities deepening on CGM technology[34]. Yuchi found relationship between HR and PA. This paper proposes a HR prediction model based. It shows use of HR in various fields as cardiopathy research and diagnosis heart attack warning indicator[35]. Babusiak and Mohylova reported EEG signal prediction by using neural network. In this paper the EEG signal prediction can be used for automated detection of irregular heartbeat-extra stole[36].

Zainuddin et al. discussed a neural network approach in predicting the blood glucose for diabetic patients. it also lead to risk of heart attack, kidney disease and renal failure, the proposed system makes separate blood glucose prediction in the morning afternoon evening and night[37]. Forouzanfar et al. offered a description and comparison with conventional maximum amplitude algorithm and NN based method and discussed about feed-forward and cascade forward are employed to BP using the preprocessed OAS[38]. Temurtas et al. reported comparative Pima diabetes disease diagnosis was realized for this multilayer neural network. Structure is Levenberg Marquardt (LM) algorithm and probabilistic Neural Network structure was used[39]. Tasdelen et al. reported Artificial Neural Network analysis for prediction of Headache prognosis in elderly patients. In this paper investigate the ability of NNS to detect and classify the complete improvement of headache in elderly patients[40].

Thakur et. al have found Early Diagnosis of Ischemia Stroke Using Neural Network. Discussed about other techniques with ANN Model[41]. Studenmayer et al. developed and tested two ANN to apply to physical activity data collected with used uniaxial accelerometer the ANN model estimated physical activity metabolic equivalents [MET] and other ANN identified activity type[42].

Artificial neural network had been used by Menendez et al. applied to cancer detection in a breast screening program. In this paper describes NN based approach to breast cancer diagnosis. The model develop is able to determine person suffer from a kind of tumor before undergo a mammography[43]. Ayer et al. offered a description Breast cancer Risk Estimation and calibration risk assessment model and ability to predict abnormality from malignant once[44]. Ganesan et al, presented ANNS have been successfully applied for both problems in pre-clinical and post-clinical diagnosis ANNs has been used to analyze demographic data and developed diagnostic algorithms[45].

Gavrovska et al. they presented efforts to predict whole fundamental hart sound (s1 and s2) ANN-based detection using simple features vector and annotated database 99% of accuracy is presented in this work[45,91]. Aladag et al. presented in this paper artificial neural network are used for model brain wave which recorded during Wisconsin card sorting test that proved ANN successfully model[46]. Dietzel et al. found in breast MRI (B.M.R.I) prediction of lymph node metastases (NT) on the basis of dynamic and morphologic descriptors of breast cancer remains[47]. Peralta et al. introduced Time Series Forecasting by Evolving ANN Network using Cross-Validation and Ensembles. In this paper discussed ACTF are important for business, engineering system Evolutionary system etc[48].

Atkov et al. have designed an artificial neural network –based diagnostic model for coronary heart disease (HD) using a complex of traditional and genetic factors of disease[49]. Kadhim and Shayea contributed Artificial Neural Network in Medical Diagnosis. In this paper discussed about acute nephritis disease and second heart diseases .used in Single Proton Emission Computer Tomography[50]. Vanisree K and Singaraju in this paper discussed proper diagnosis an early stage can significant life saving. Decision Support System has been propped for diagnosis For Congenital Heart disease[51].

Gohari et al. determine the prognostic factors in Iranian colorectal cancer (CRC) patients compared to Cox regression model[52]. Soni et al. show to design a GUI based interface predict whether the patient is having heart disease or not using weighted association rule based classifier[53].

Catalogna et al. artificial neural network based controller for glucose monitoring during clamp test. It presented and improved clamp control algorithm motivates it. While using blood samples required for evaluation of IR. Glucose pump control algorithm based on ANN modal was developed[54]. Allam et al. found scalable closed loop blood glucose regulation system. He used auto melted closed loop control .RNN is used nonlinear predictor and fuzzy logic controller is used to determine insulin dosage NMPC is evaluated by applying full they meal regime to each patient[55]. Santhi and Kumar, offered a description and comparison of CGM continuous glucose monitoring and NNS with the extracted features of C.G.M.S data time series. As a result ANN is better than CGM[56].

Artificial Neural Network applied for kidney stone diagnosis and compared two neural network techniques back propagation algorithms (BPA), radial basis function (RBF) and NON linear classifier support vector machine (SVM) have been compared with efficiency and accuracy by using WEKA 3.6.5 tool used for implementation the best technique[57]. Esfandiari et al. applied neural network approach to hair loss diagnosis. In this paper focus is put on eight influence attributes of gender, age, genetic, factors, surgery, pregnancy zinc deficiency iron deficiency anemia and the use to cosmetics the amount of hair loss predicted[58]. Kumar and Abhishek offered description and comparison of three neural network algorithms learning vector quantization (LVO), two layers feed forward perception trended with back propagation training algorithm and radial basis function it used weka version 3.7.5 as simulation tool[59].

Jadhav et al. found artificial neural network (ANN) based cardiac arrhythmia disease diagnosis system used for train and test arrhythmia analysis backprogration time algorithm with momentum tearing rules[60]. Gupta et al. focused on some of the technique proposed for arrhythmia classification and extraction of parameters from the ECG signal which is used for data acquisition and classification system[61].

Ashwarya et al. contributed a classification used machine learning technique for Diabetes with support vector machine (SVM) is used. SVM is used for classification of system[62]. In other application Rahman et al. compared and explore the process of constructing common predictive models ANN multilayer perception and binary logistic were applied and compared with diabetes mellitus (DM)[63]. Amota et al. discussed in this paper a briefly review the philosophy, capabilities and limitation of artificial neural network in medical diagnosis[64]. Manjusha et al. introduced the classification of heart disease data set multilayer feed forward net works with back propagation algorithm to increase the efficiency of classification[65].

Kumar and Saini found lung cancer by analyzing chest x-rays image to extract the area[66]. Kumar et al. contributed early diagnose of lung cancer with ANN. FCM and FM, NN. In this paper suggest using FCM and FMNN to diagnose[67].

Awing and Siraj Arficial neural network helped in predicting mainly the angina in patients .in this paper introduced heart disease management information system (HDMIS) neural network similar (NNS) and prediction system (PS) on patient's data[68]. In another application of Gharehchopogh et al. contributed artificial neural network in diagnosis of thyroid disease. In this paper they consider a multi layer perception (ANN) using back propagation learning algorithm to classified thyroid disease[69]. Sansone et al. reviewed methods ECG processing form a pattern recognition perspective focus other techniques such as hidden Markov models and kalman filtering we be also mentioned[70].

Mitra and Samant estimated new approach for cardiac arrhythmia disease classification in this paper attempts correlation based feature selection (CFS) with linear forward selection they used incremental back rogation neural network (I.B.L.N) and Liebenberg Morquardt for test[71]. Sao et al. discussed about the analysis ECG signal is an application of pattern recognition the ECG signal feature extraction parameters such as spectral entropy Poincare plot and lyapunov exponent are used[72]. Pandey and Garg used twin paradigms of modularity and swarm intelligence based optimamization could be successfully this approach has been used for the diagnosis of breast cancer disease[73].

Artificial Neural Network has been used by Shrivastav and Dubey, in LIE DETECTION system. In this paper they demonstrated that use non-impassive physiology sensing to detect stress and lying with ANN. It shows simply derived non – invasive physiological features as voice pitch variation [74].In other application Wadhonkar et al. decided the classification of heart daisies dataset multilayer feed forward neural network with back Propagation algorithm proposed[75].

Waghulde Patil discussed in his paper Genetic Neural Approach (GNA) for heart disease prediction. Which train network with neural network architecture and uses the global optimization of genetic algorithm the result predicts up to 98 % accuracy[76,91,92]. Dheeba et al. presented computer aided diagnosis helper the radiologist in detecting abnormalities with an efficiency .In this paper Investigates a new classification approach for breast abnormalities in digital mammograms using partial swarm optimized wavelet neural network (PSOWNN) the result shows are under ROC URVED proposed algorithm is 0.96853. Sensitivity 94.1671 and specificity of 92.105%[77]. Chun Lin et al. designed a method cuff with piezofilms sensor a pressure sensor to collect signals from bronchial artery is investigating using NN to classify an algorithm is developed in signal processing and heart rate detection software[78].

Ozden et al. found in his paper proposed study was proposed to develop an identification unit for classifying periodontal disease using support vector machine (SVM) decision tree (DT) and artificial neural network (ANN's) and result shown DT and SVM were best to classify disease with high accuracy[79].

Florence et al. proposed in this system which used neural network and decision tree (ID3) to predict the heart attacks and one with worst performance technique the result is more accurate output them the other techniques[80]. Sharma and Hari have offered a description on cascade correction neural network modal has built and combine together cascade architect and learning algorithms together as a result it estimated to be 10 time faster then back progration algorithms and cascade is effective modal[81]. Rastogoi and Bhalla offered a study of neural network in diagnosis of thyroid disease in his paper neural network feed forward neural network used to classify the thyroid disease using back propagation algorithm[82].

Never et al. focused on development of a diagnosis support system built under a work based on logical programming[83]. Kaur and Sing contribution a NN and SVM model for early detection of lung cancer one of the most common form of medicine malpractices globally an error in diagnosis using SVM and BPNN it achieve 98% accuracy[84].

Artificial Neural Network has been used for heart diseases diagnosis. It was used to confirm whether heart disease in present or absent. This results of obtained 85%, 87.5% that support vector machine is the best network for the diagnosis of heart disease[85]. Mane and Chougule et al. contributed a review on neural network methodology for diagnosis of kindly stone. In this paper kindly disease detector is a system detects abnormalities in kindly[86]. Mandal and Baneryse here multilayered feed forward Neural Network was used to detect cancer from Microarray data and UCI machine hearing data. It was found that ANN model can classifier data with good accuracy[87]. Hambire and Ganorkar have found an automatic hieraranchical procedure to classify and stage liver disease using ultrasound images is described ultra son graphic images k-mean clustering used to analyze liver disease[88].

Perrine and Sehgal has offered a description and comparison of GD, LM and SCG method of neural network for thyroid disease diagnosis. The main purpose of this work is to propose pose best technique for diagnosis of disease and improve the effluence and accuracy[89]. Vijayarani and Dhayanand have offered to predict kidney disease by using support vector machine (SVM) and artificial neural network from the experimental result of the ANN is better than other algorithms[90].

Husain et al. have computer aided diagnosis (CAD) for lung cancer using ANN on CT scan image. Result of this paper was that early detection of lung cancer cans curare the change of survival among people[93]. Hussin et al. have discussed about Computer Aided Diagnosis for Lung cancer using ANN intelligence on CT scan images[94].

Bewal et al. has contributed in review of detection of breast cancer using neural network. In this paper classical methods required for cytopathologists or oncologists to examine breast lesion detection and classification. As a result in carcinogenesis ANN have been successfully applied paper clinical and post clinical[95].

Hadrat et al. was used for inflation forecasting in Ghana Artificial neural network model Approach In this paper forecasts using ghanam dataset results show that the RMSFE are lower that ANN models[96]. Zakhmi has offered a description on tuberculosis disease using data mining techniques' it show both Genetic Algorithm and neural network backwash better than other techniques[97]. Bhalerao and Gunjal reported that Artificial Neural Network and k-means are combined to achieve an efficient result in heart disease diagnosis[98]. Elgil et al. have found a special type of artificial neural network ,the time sensitive ANN (TS-ANN) predict hypoglycemia even a head of time TS-ANN based system was able to predict hypoglycemia with accuracy[99].

Soltani and Jafarian have found a new artificial Neural Networks approach for Diagnosing Diabetes Disease Type II. According to this paper PNN is implemented in MATLAB. Furthermore, maximizing accuracy of diagnosing the Diabetes disease. We conclude that training accuracy and testing accuracy of the proposed method is 89.56% and 81.49%, respectively[100].

## Conclusion

Recent 100 significant contributions during the period of 1991 to 2016 have been reviewed to identify applicability of Neural Network, Non- Linear dynamic system. In this study ANN technique has been implemented to predicted different disease in people. It is conclude that the neural network models as BP, SVM, MLP, RB are Sufficiently Suitable for prediction of daisies.

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