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Pre-Diagnosis of Hypertension Using Artificial Neural Network

Yousif Elfatih Yousif
Department of Computer Engineering, Faculty of Engineering, Alzaiem Alazhri University, Khartoum, Sudan

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Abstract:

This paper aims to use artificial neural network ANN to contribute to pre-diagnosis of hypertension prediction, In this paper used the MATLAB to building ANN model in this model a number of people were tested to predict whether they had blood pressure disease or whether they were not infected this paper found the performance of pre-diagnosis of hypertension using artificial neural network is good method for healthcare based on results the accuracy of model reaches 81 % the proposed neural network is back propagation neural network incudes of seven input neurons in the input layer which are the factors of hypertension, four hidden neurons in the hidden layer The node of the output layer is the one that gives the classification for the data. It classifies that are having hypertension or not having hypertension.

Keywords: *artificial neural network, pre-diagnosis, hypertension, MATLAB, back propagation, neurons.*

Introduction

Artificial intelligence is a sub-computer science that is concerned with creating software and hardware components capable of simulating the human mind. Computers have the ability to simulate some of the capabilities of the human mind, such as performing mathematical operations, processing numbers and letters, making some decisions, in addition to the superior ability to store and retrieve information. the science of artificial intelligence aims to simulate some of the processes of perception and logical deduction that humans are fluent in automatically and at a high speed, as well as the completion of many difficult and complex tasks that were done manually using advanced artificial intelligence techniques.

The use of knowledge in the medical field is to transfer the doctor's experience in diagnosing the disease to the computer. the electronic diagnostic system has many advantages such as speed in diagnosis and giving appropriate treatment even if the information is incomplete, and this is in the case of an expert or not, as we find that medicine is one of the preferred fields for the development of expert systems and one of the oldest computer applications in the field of medicine were related to patient records to improve the administrative structure on the one hand and obtain more information about diseases on the other hand, and medical histories often constitute the material of databases in the light of which certain statistics can be deduced.

After this, the problem of using computers to make a medical diagnosis was confronted, either by using the available databases to deduce an important relationship that shows symptoms and diagnoses by applying different computational methods, or, as was done recently, by using methods taken from the field of artificial intelligence, such as expert systems, which is one of the most important methods.

Doctors and computer scientists since the mid-fifties realized the extent to which computers help in making clinical decisions, and then began to analyze medical diagnoses with a view to the potential role in the possibility of computerizing assisting decisions in that field. various methods have been discovered for this and these methods contain: the use of medical algorithms or flowcharts that translate sequential events the use of a wide database to store previous cases of a group of patients and compare them with current cases that lead to improved treatment of similar cases.

Methodology

This paper presented pre-diagnosis of hypertension using artificial neural network, ANN is a part and parcel of intelligent based systems, designed distinctively to improve the performance of conventional computing techniques. The biggest drawback associated with the so called conventional methods is the inability to learn and identify patterns in dynamic systems to solve this problem we use artificial neural network, to design and implement the proposed model was used MATLAB Environment.

Architecture of Artificial Neural Networks

Work on artificial neural networks, commonly referred to as neural networks has been motivated right from its inception by the recognition that human brain computes in an entirely different way from the conventional digital computer Artificial Neural Network is an information processing paradigm inspired by the way biological nervous systems, such as the brain, process information. The architecture illustrated in fig 1, presents a three-layered feedforward network. ANN has a remarkable capability to develop sense from convoluted or imprecise data, extract patterns and detect trends that are too complex often only noticeable by either humans or other computer techniques.

In broad terms, ANN-based models offer a variety of benefits namely: adaptive learning, self-organization, real time operation, fault tolerance via redundant information coding. Thus, neural network processes information in the similar way the human brain does. The neurons are organized in a way that defines the network structure. The most concerned structure is the multilayer perceptron (MLP) type, in which the neurons are organized in layers. The neurons in each layer may share the same inputs, but are not connected to each other. If the architecture is feed-forward, the outputs of one layer are used as the inputs to the following layer. The layer between the input neurons and the output layer are called the hidden layer.

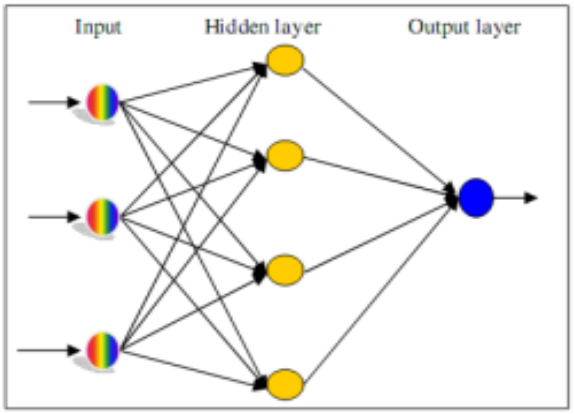

Figure 1. Architecture Structure of Neural Network

Proposed Model

Designing ANN models follows a number of systemic procedures. In general, there are five basics steps: (1) collecting data,

(2) preprocessing data, (3) building the network, (4) train, and (5) test performance of model fig 2 shown the steps of ANN model.

(1) Data Collection

Collecting and preparing sample data is the first step in designing ANN models.

(2) Data Pre-Processing

After data collection, three data preprocessing procedures are conducted to train the ANNs more efficiently. These procedures are:

(I) Solve the problem of missing data,

(II) Normalize data and

(III) Randomize data.

(3) Building the Network

At this stage, the designer specifies the number of hidden layers, neurons in each layer, transfer function in each layer, training function, weight/bias learning function, and performance function. In this work, multilayer perceptron (MLP) and radial basis function (RBF) networks are used.

(4) Training the Network

During the training process, the weights are adjusted in order to make the actual outputs(predicated) close to the target (measured) outputs of the network.

(5) Testing the Network

This step is to test the performance of the developed model. At this stage unseen data are exposed to the model.

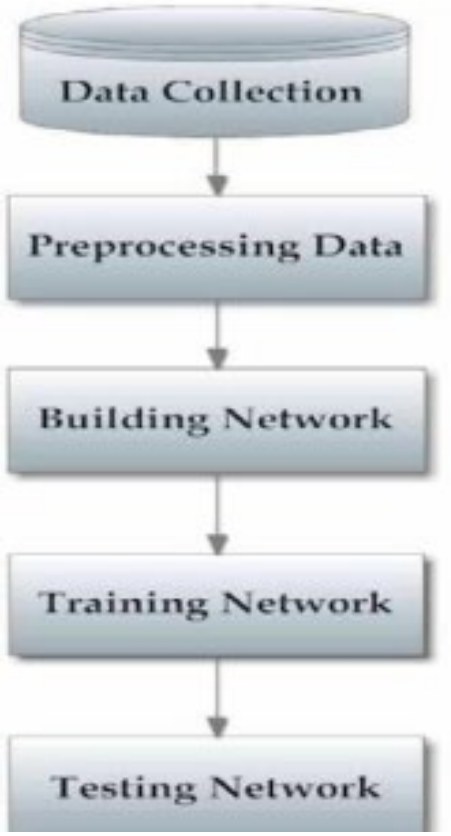

Figure. 2 Basic Flow for Designing Artificial Neural Network Model

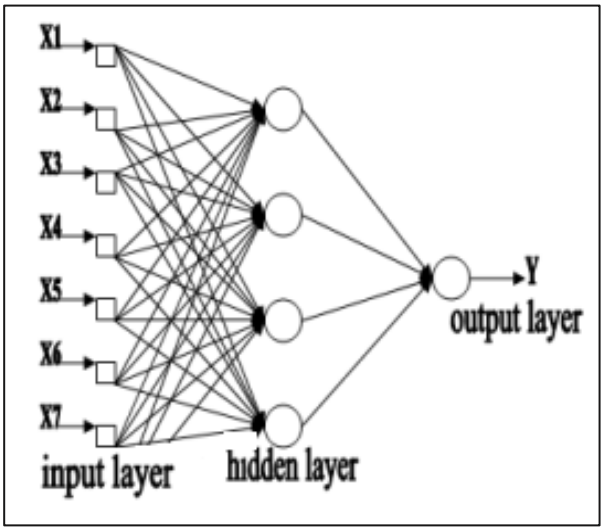

Figure. 3 Proposed Neural Network

The proposed neural network designed in this paper shows in fig 3 is a Back propagation neural network incudes of seven input neurons in the input layer which are the factors of hypertension, four hidden neurons in the hidden layer The node of the output layer is the one that gives the classification for the data. It classifies that are having hypertension or not having hypertension.

Programming of the Neural Network Model

MATLAB is a numerical computing environment and also a programming language. It allows easy matrix manipulation, plotting of functions and data, implementation of algorithms, creating user interfaces and interfacing with programs in other languages. The neural network toolbox contains the MATLAB tools for designing, implementing, visualizing and simulating neural networks. It also provides comprehensive support for many proven network paradigms, as well as graphical user interfaces (GUIs) that enable the user to design and manage neural networks in a very simple way. MATLAB is used to write script files for developing MLP, RBF, ANN models and performance functions for calculating the model.

Steps of create ANN in MATLAB:

1. Create a network

For this example, you use a feed-forward network with the default tansigmoid transfer

function in the hidden layer and linear transfer function in the output layer. This structure is useful for function approximation (or regression) problems. use 20 neurons (somewhat arbitrary) in one hidden layer. The network has one output neuron, because there is only one target value associated with each input vector.

net = newfit (houseInputs, houseTargets , 20)

Figure.4 Network Training Window

2. Train the network

The network uses the default Levenberg-Marquardt algorithm for training, the application randomly divides input vectors and target vectors into three sets as follows:

- 60% are used for training

- 20% are used to validate that the network is generalizing and to stop training before overfitting

- the last 20% are used as a completely independent test

of network generalization to train the network, enter:

net = train (net, houseInputs, houseTargets);

During training, the following training window opens. this window displays training progress and allows you to interrupt training at any point by clicking stop training, the neural network illustrated in fig 4, the best validation performance shows in fig 5.

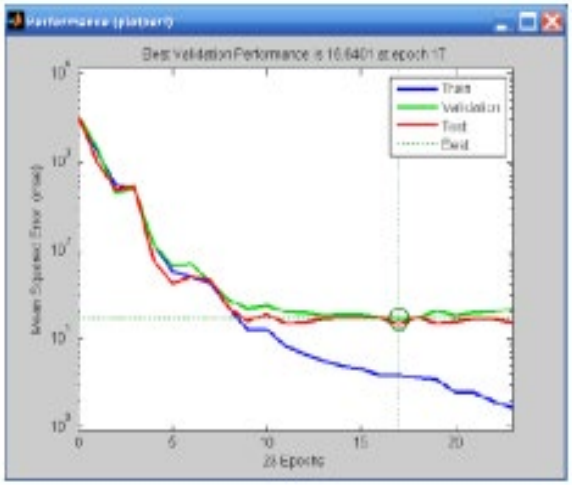

Figure.5 Best Validation Performance

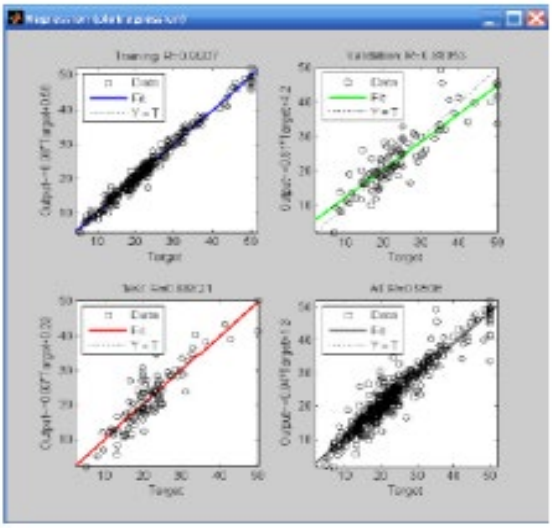

Figure. 6 Regression Network Training Window

If clicked regression in the training window, can perform a linear regression between the network outputs and the corresponding targets. the fig 6 shows the result.

Results and Discussion

This model is defined seven factors of interest as input variables in artificial neural network model as described in Table 1. these included

A. age

The incidence of blood pressure increases with age, as it is associated with a number of effects of age for example: stable age <40, unstable age>= 40.

B. Gender

High blood pressure is more common in men than women until the age of 45, and after this age, specifically until the age of 64, the percentages are similar between men and women who suffer from high blood pressure

C. Body Mass Index (BMI)

BMI refers to a height/weight ratio and is calculated as weight in kilograms divided by height in meters squared. BMI values are classified into one the following three classes: Underweight, Normal and Overweight based on the BMI of the corresponding individual

D. Urine Albumin-Creatinine Ratio

The Albumin/Creatinine Ratio is used to screen people with chronic conditions, such as diabetes and high blood pressure and is, therefore, used as a factor in this model.

E. Cholesterol, Lipoproteins and Triglycerides

Cholesterol, triglycerides, and high-density lipoproteins are important constituents of the lipid fraction of the human body. Cholesterol is transported in the blood by both high and low density lipoproteins . An individual's total cholesterol count is made up of one fifth of their triglyceride level along with their HDL and LDL cholesterols.

Table 1. Factors Of Interest as Input Variables in Artificial Neural Network Model

ANN Input	Factors	Comment
X1	Age	(Stable, Unstable)
X2	Gender	(Male, Female)
X3	Cholesterol	(Low, Normal, High)
X4	Body Mass Index	(Underweight, Normal, Overweight)
X5	Urine Albumin-Creatinine Ratio	(Normal, Up normal)
X6	Lipoproteins	(Low, Normal, High)
X7	Triglycerides	(Low, Normal, High)

Depending on the designed model, a number of people were tested to predict whether they had blood pressure disease or whether they were not infected Table 2 shown testing data by using ANN model this table consists of one column (Predictive Result) that is used for the prediction result. This prediction would be compared to the (Real Result) column to calculate the accuracy.

Table 2. Testing Data by Using ANN Model

NO	Predictive Result	Real Result
1	Positive	Positive
2	Negative	Positive
3	Negative	Negative
4	Negative	Negative
5	Positive	Positive
6	Positive	Positive
7	Negative	Positive
8	Negative	Negative
9	Negative	Negative
10	Positive	Negative

Figure 7 shows the confusion matrix generated for 180 persons and confusion matrix is representation of the performance of model the blue blocks demonstrate correct classifications (45% true positives and 36.1% true negatives) and the orange blocks show incorrect classifications (10.5 % false positives and 8.4% false negatives). the green blocks demonstrate accuracy of the model for each case and the gray block shows overall accuracy of the model.

N=180	Positive	Negative	
Positive	81 45 %	19 10.5 %	Correct 81% In correct 19 %
Negative	15 8.4 %	65 36.1 %	Correct 81.3% In correct 18.7 %
	Correct 84.3% In correct 15.7 %	Correct 77.4 % In correct 22.6 %	Correct 81% In correct 19 %

Figure 7. Confusion Matrix

Conclusion

This paper designed a predictive Artificial Neural Networks model to pre-diagnosis hypertension this model achieves an impressive 81% accuracy to design and implement the proposed model was used MATLAB Environment. this model has been used to develop a system in which people would be able to self-diagnose themselves and also it helps the doctor to discover for better medication and provide the patient with early diagnosis of hypertension, the computing world has a lot to gain from neural networks. Their ability to learn by example makes them very flexible and powerful, Neural network will never be replaced conservative methods, but for a growing list of

applications, the neural network architecture will provide for a complement to these existing techniques, Artificial Neural Networks is a powerful technique that has the ability to emulate highly complex computational machines.

References

Abdullah, A., Zakaria, Z., & Mohamad, N.F. (2011). Design and Development of Fuzzy Expert System for Diagnosis of Hypertension. *2011 Second International Conference on Intelligent Systems, Modelling and Simulation*, 113-117. https://doi.org/10.1109/ISMS.2011.27

Das, S., Ghosh, P.K., & Kar, S. (2013). Hypertension diagnosis: A comparative study using fuzzy expert system and neuro fuzzy system. *2013 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, 1-7. https://doi.org/10.1109/FUZZ-IEEE.2013.6622434

Kaur, A., & Bhardwaj, A. (2014). Artificial Intelligence in Hypertension Diagnosis: A Review. *International Journal of Computer Science and Information Technologies, 5*(2), 2633-2635.

Lin, Z., Chang, C., Chou, N., & Lin, Y. (2014). Bluetooth Low Energy (BLE) based blood pressure monitoring system. *2014 International Conference on Intelligent Green Building and Smart Grid (IGBSG)*, 1-4. https://doi.org/10.1109/IGBSG.2014.6835225

Samant, R.M., & Rao, S. (2013). Evaluation of Artificial Neural Networks in Prediction of Essential Hypertension. *International Journal of Computer Applications, 81*, 34-38. https://doi.org/10.5120/14067-2331

Silipo, R., & Marchesi, C. (1998). Artificial neural networks for automatic ECG analysis. *IEEE Trans. Signal Process., 46*, 1417-1425. https://doi.org/10.1109/78.668803

Srivastava, P., Srivastava, A., Burande, A. & Khandelwal, A. (2013). A Note on Hypertension Classification Scheme and Soft Computing Decision Making System. *ISRN Biomathematics, 2013,* 1-11. https://doi.org/10.1155/2013/342970

Sumathi, B.B., Santhakumaran, D.A., & Coimbator (2011). Pre-Diagnosis of Hypertension Using Artificial Neural Network. *Global journal of computer science and technology*,11(2), 43-47.

Xu, L., Guo, X., Yang, F., Yin, S., Zhang, X., & Meng, M.Q. (2012). Implementation of cuff-less continuous blood pressure measurement system based on Android. *2012 IEEE International Conference on Information and Automation*, 552-556. https://doi.org/10.1109/ICINFA.2012.6246866

Yousif, Y. & Mustafa, A. (2017). Cryptography Techniques based on Neural Networks. *International Journal of Advanced Research in Computer Science and Software Engineering, 7,* 308-

311.
https://doi.org/10.23956/ijarcsse/V7I3/01323

Yousif, Y. & Mustafa, A. (2017). Performance Enhancement of RSA Algorithm Using Artificial Neural Networks. *International Journal of Computer Science and Mobile Computing, 6*(1), 21-27.

Yousif, Yousif. (2020). Improving the efficiency of des algorithm using neural networks. *International Journal of Engineering Applied Sciences and Technology, 5,* 26-29. https://doi.org/10.33564/IJEAST.2020.v05i01.004