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Survey on Effective Kidney Stone Disease Diagnosis Using ANN

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ABSTRACT: In medical field the diagnosis of Kidney disease is most difficult task. It depends on the careful analysis of different clinical and pathological data of the patient by medical experts, which is complicated process. This paper presents a review of the literature on the artificial neural network for Disease Diagnosis. This survey reports that multilayer perceptron Network (MLP) is best architecture for kidney disease diagnosis. This survey also reports that disease diagnosis using ANN technique is more suitable than traditional statistical and numerical methods.

KEYWORDS: ANN; Literature Review; Architecture; Medicine; Kidney Stone

I. INTRODUCTION

The ANN is plays a critical and key part in human body. In human body work is done with the assistance of neural network. A Neural Network system is representation of the human brain and motivate its learning process. An artificial neural system consists of various extremely simple processor, additionally called neurons, which are undifferentiated from the biological neurons in the mind.

The term neural network was generally refers to a system of organic neurons. The advanced use of the term allude to neural systems, which are made out of neurons. In this manner the term has two particular utilizations, Biological neural systems and Artificial Neural Networks [1].

Natural neural systems are collection of genuine organic neurons that are connected for peripheral nervous system or central nervous system. In the field of neuroscience, they are recognized as a gathering of neurons that performs a particular physiological capacity in the research facility investigation. Neural systems are made out of interconnection neurons. This systems might either be utilized to pick up a comprehension of natural neural systems, or for taking care of computerized reasoning issues.

The neural systems show mapping capacity, they can guide information example to their related yield designs. They can learn by illustrations. Neural system architectures can be prepared with known samples of an issue before they are tried for their inference limit on unknown examples of the issue. They can distinguish new objects previously untrained. They have the ability to sum up. Along these line, they can anticipate new results from past patterns. They are vigorous frameworks and shortcoming tolerant. They can review full pattern from partial or noisy examples. They can likewise transform data in parallel, at fast and in a circulated way.

II. LITERATURE REVIEW

Dr. S. Vijavarani et al. (2015) predicted kidney diseases by using Support Vector Machine (SVM) and Artificial Neural Network (ANN). The goal of research is to measure performance of these two algorithms on the basis of its accuracy and execution time by comparing these two algorithm. The results it show that the performance of the neural network is better than the any other algorithm [12].

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Lara Dantas et al. (2015) studied to use neural networks such as Multi-layer Perceptron, Extreme learning Machine and Reservoir computing to performing early diagnosis of a patient with or without AD and Mild Cognitive Impairment (MCI), and for another common type of disease. This paper also give detail to utilize the Random Forest Algorithm and the feature selection method available on Weak called Info Gain Attribute Eval to select proteins from the original set and, thus, make a new protein signature. Through experiments result show that the best performance was obtained with the MLP and the new signatures created with the Random Forest achieved better results than any other system [11].

Koushal Kumar et al. (2012) did research on kidney stone disease diagnosis by utilizing three different neural network algorithms which have different architecture and characteristics. The goal of this research was to compare the performance of all three neural networks on the basis of its accuracy, time taken to build model, and training data set size. They used Learning vector quantization (LVQ), two layers feed forward perceptron trained with back propagation training algorithm and Radial basis function (RBF) networks for diagnosis of kidney stone disease. In this research they used Waikato Environment for Knowledge Analysis (WEKA) version 3.7.5 as simulation tool and it is an open source tools. The data they used for diagnosis is real world data with 1000 instances and 8 attributes. In the end part they checked the performance comparison of different algorithms to propose the best algorithm for kidney stone diagnosis. So that would help in early identification of kidney stone in patients and reduces the diagnosis time [6].

HasanTemurtas et al. (2008) worked on a comparative Pima diabetes disease diagnosis. For this reason, a multilayer neural network structure which was trained by Levenberg–Marquardt (LM) algorithm and a probabilistic neural network structure were utilized by them. The results of these research compared with the results of the previous studies reported focusing on diabetes disease diagnosis and utilizing the same UCI database [7].

AbdullahiUwaisu Muhammad et al.(2015) reported a brief survey on various techniques for application of artificial neural networks and the different learning in neural networks, such as supervised, unsupervised, reinforced and competitive learning it also analysis the major advantages and their drawbacks. In order to measure the perfect, efficient solutions for artificial neural networks has been widely used [9].

Jasdeep Singh Bhalla et al. (2012) proposed two different artificial neural networks for disease diagnosis, which uses Scaled Conjugate gradient back propagation and Levenberg-Marquardt back propagation algorithm for training the neural networks. The proposed model has been tested on a dataset about Thyroid disease collected from a local hospital. These samples are first trained using Levenberg-Marquardt propagation and outcomes are measured, then the same samples are trained by means of Scaled Conjugate gradient back propagation algorithm and results are noted. The algorithm used is capable of distinguishing amongst infected person or non-infected person. The results from the two models are compared and analysed to show the efficiency of prediction by ANNs in medical diagnosis [8].

A. *Data Source*

The performance of the ANN is evaluated on Cleveland Kidney disease database that was taken from UCI machine learning repository. This dataset have 400 records with each having 14 clinical attributes that include Age, Blood pressure, Blood urea, Specific gravity, Red blood cells, Hemoglobin sugar, Hypertension Serum creatinine, Diabetes mellitus, Pedal edema, Anemia, Bacteria, Sodium, Pus cell number of vessels collared and that respectively. In this dataset out of 400 records 250 belong to Healthy category and 150 belong to kidney stone disease.

B. *Training the NN*

Once a network has been structured for a specific application, that network system is now ready to be training process. To start this training the initial weights are selected randomly. Then, the training process or learning, starts. The Neural Network is trained by exposing it to a set of existing data where the output is known. Multilayer networks use a various learning techniques; the most famous is back–propagation (BP) algorithm.

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It is one of the most effective and useful approaches for machine learning algorithm in which, information flows from the direction of the first layer towards the last layer [10].

There are two approaches to training process of ANN - supervised and unsupervised. Supervised training involves a mechanism of providing the ANN with the desired output either by manually "grading" the network's performance or by giving the desired or expected output with the inputs. Unsupervised training process is where the ANN has to make sense of the inputs without any external help [10].

Training in Neural Network is done *via* examples, by adjusting the connection weights in NN's iteratively. The number of iterations of the training process and the convergence time varies based on the weight initialization. After the repetition of the processes, for a sufficiently large number of training epochs, the NN system usually converges to a state where the error in the calculations is small thus implying the network to be learned to a specific function [10].

C. *Selection Of Weights*

The weights on all the joining are set at small random numbers and the NN system is called to be "untrained". The weights of each node were randomly initialized to values between -1 and +1.Weight training in network is usually formulated as minimization of an error function [xin] has the MSE (mean square error) between target output and actual outputs averaged over all examples, by iteratively adjusting connection weights at nodes.

The weights are adjusted in such a manner that each weight adjustment for node increases the likelihood that the network will compute. To adjust, weights are measured by calculated and the weights are then changed for decreasing error. The prospect of best convergence depends on the weight initialization scheme. For this reason, back propagation can only be applied on networks with differentiable activation functions [10].

D. Data Description and Training Data

The ANN system for diagnosis of kidney disease using multilayer perceptron neural network is created in MATLAB R2012. In this ANN system the dataset is separated in to two parts randomly like training set and testing set. Out of total dataset 70% records are used for training and 30% records used for testing. The measurement of performance of the ANN system is achieved computing the percentage value of different.

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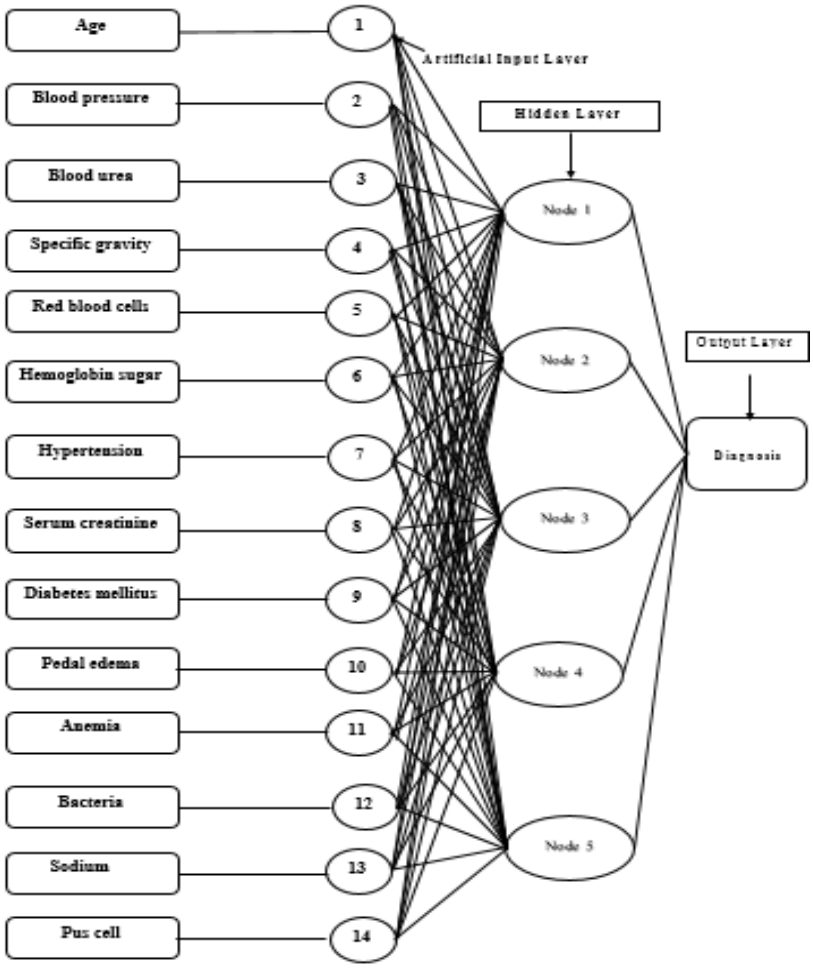

Fig 1: Neuron Model with 14 Input and 5 Hidden Layer

III. ARCHITECTURE OF NEURAL NETWORKS

A. *Feed-forward networks*

A simple neural network type where synapses (connection) are made from an input layer to zero or more hidden layers and ultimately to an output layer. Feed-forward ANNs allow signals to travel one way only; from input to output. A straightforward neural system type associations are produced using an information layer to zero or more hidden ultimately to last layers and layer. Feed forward ANNs permit signs to travel one path just; from first layer to output layer [1].

Feed-forward systems usually utilize the BP learning calculation to progressively change the weight and boas values for every neuron in the system [2].

Feed-forward networks are especially suitable for applications in restorative imaging where the input and output are numerical and sets of input/output vectors give a reasonable basis to preparing in a supervised way [2].

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B. *Feedback network:*

Feedback networks can have signals travelling so as to go in both direction in the systems. Feedback networks are effective and can get amazingly confused. Feedback systems are rapid; their "state" is changing continuously until they achieve a harmony point. They stay at the balance point until the data changes and another balance should be found. Feedback architectures are additionally alluded to as intelligent or repetitive, despite the fact that the last term is frequently used to indicate input associations in single layer associations [1, 3].

C. *Hopfield Neural Network*

A basic single layer recurrent neural system. The Hopfield neural system is prepared by means of a calculation that shows it to figure out how to recognize pattern. Hopfield neural systems are regularly utilized for pattern recognition [3].

D. *Back-Propagation Classified*

Back propagation is form of supervised learning. The learning algorithm for multilayer perceptron's. The term back propagation means the backward propagation of error signal through the network. After propagating a pattern through the system –feed forward, the output pattern is compared with a given target and the error of each output unit is measured. This error is spread in reverse to the input layer – back propagation. Finally the unit's error are utilized to alter the weights [4].

The neural network architecture is illustrated in the below figure.

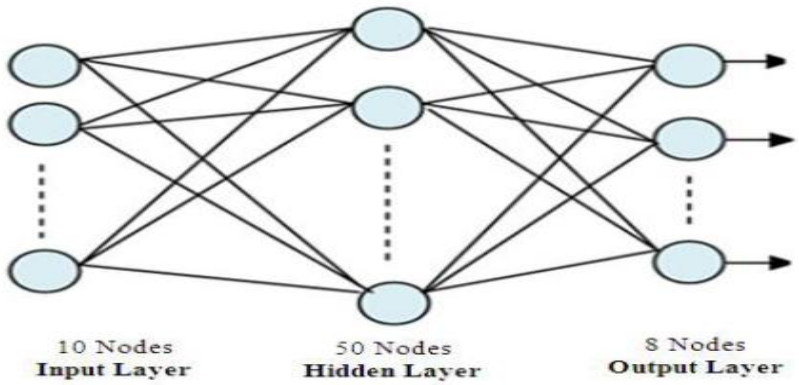

Fig. 2. The architecture of B-P ANN [4]

IV. NEURAL NETWORK IN MEDICINE

The ANN is application to biomedical frameworks in the following couple of decades. The exploration is concentrating on demonstrating parts of the human body and perceiving infections from different scans. Neural Networks are perfect in recognizing disease by utilizing scans there is no compelling reason to give a particular calculation on the best way to identify the disease.

Artificial neural networks have been successfully connected on different regions of medicine, for example, diagnostic systems, biomedical analysis, images analysis, drug development. Utilizing artificial neural systems, it can be checked a ton of health records (breath rate, pulse, glucose level) or can be anticipated the patient reaction to a treatment [5].

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Neural Network is very useful for image analysis. ANN are utilized in pattern recognition due to the reason of their properties to learn and to store knowledge. The medical images field is very useful and reason is that it offers a lot of important details for diagnosis and therapy [5].

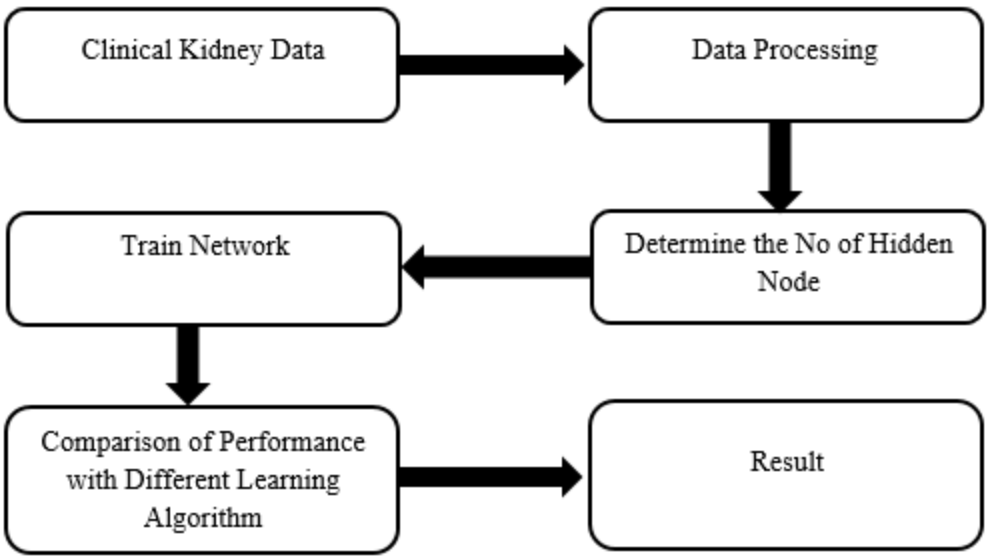

Fig 3: Block Diagram of Proposed Method

V. KIDNEY STONE

Kidney stones infection is becoming more regular now days. Kidney stones are created when certain substances in pee including calcium, oxalate, and then uric corrosive solidify. These minerals and salts structure gems, which can then join together and structure a kidney stone. Every kind of kidney stone has an alternate reason. Stones are classified according to their chemical composition. Approximately 80% of all kidneys stones are calcium oxalate stones, which are the most dangerous. The arrangement of these stones may be created by hereditary elements furthermore relies on age, and topographical variables. Be that as it may, more critical are dietary and way of life elements, and the consequences of procured metabolic imperfections prompting gem development and development of a kidney stone. In creators give a subtle element clarification in regards to what are kidney stones, its types and distinctive side effects of this sickness. In creators portray the portray the distinctive variables like Age, Blood pressure, Blood urea, Specific gravity, Red blood cells, Hemoglobin sugar, Hypertension, Serum creatinine, Diabetes mellitus, Pedal edema, Anemia, Bacteria, Sodium, Pus cell, ethnicity which may reason for kidney stones.

VI. METHODOLOGY

A. *Multilayer Perceptron Neural Network*

A multilayer perceptron is a food forward manufactured neural system display that maps sets of information onto an arrangement of suitable yield. It is a standard's adjustment straight perceptron in that it utilizes three or more layers of neurons (hubs) with nonlinear enactment works, and is more intense than the perceptron in that it can recognize information that is not directly distinguishable, or divisible by a hyper-plane. Backpropogation is the most broadly connected learning calculation for multilayer perceptron in neural systems. [6].

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Backpropogation employs gradient descent to minimize the squared error between the network output values and desired values for those outputs. These error signals are used to calculate the weight updates which represent knowledge learnt in the networks. The performance of Backpropogation algorithm can be improved by adding a momentum term [6].

B. *Learning Vector Quantization*

Learning Vector Quantization(LVQ) is a supervised version of vector quantization that can be used when we have labelled input data. This learning technique uses the class information to reposition the Verona vectors slightly, so as to improve the quality of the classifier decision regions.

A Learning Vector Quantization Network (LVQ) has a first competitive layer and a second linear layer. The competitive layer learns to classify input vectors in much the same way as the competitive layers of Self-Organizing Nets. The linear layer transforms the competitive layer's classes into target classifications defined by the user. The classes learned by the competitive layer are referred to as subclasses and the classes of the linear layer as target classes. Both the competitive and linear layers have one neuron per class. LVQ learning in the competitive layer is based on a set of input/target pairs. The second layer needs no learning as the output classes are known for each input pattern [6].

C. *Redial Basis Function*

A Radial basis function (RBF) network is a special type of neural network that uses a radial basis function as its activation function. A Radial Basis Function (RBF) neural network has an input layer, a hidden layer and an output layer. The neurons in the hidden layer contain radial basis transfer functions whose outputs are inversely proportional to the distance from the centre of the neuron. RBF networks are very popular for function approximation, curve fitting, Time Series prediction, and control problems. Because of more compact topology then other neural networks and faster learning speed, RBF networks have attracted considerable attention and they have been widely applied in many science and engineering fields [6].

In RBF networks, the outputs of the input layer are determined by calculating the distance between the network inputs and hidden layer centres. The second layer is the linear hidden layer and outputs of this layer are weighted forms of the input layer outputs. Each neuron of the hidden layer has a parameter vector called centre [6].

Radial basis networks may require more neurons than standard feed-forward back propagation networks, but often they can be designed in a fraction of the time it takes to train standard feed-forward networks. They work best when many training vectors are available.

D. *Probabilistic Neural Networks*

Probabilistic neural networks can be used for classification problems. When an input is presented, the first layer computes distances from the input vector to the training input vectors, and produces a vector whose elements indicate how close the input is to a training input. The second layer sums these contributions for each class of inputs to produce as its net output a vector of probabilities. Finally, a competetransfer function on the output of the second layer picks the maximum of these probabilities, and produces a 1 for that class and a 0 for the other classes.

Probabilistic neural networks (PNN) can be used for classification problems. Their design is straightforward and does not depend on training. A PNN is guaranteed to converge to a Bayesian classifier providing it is given enough training data. These networks generalize well.

E. *Self-Organizing Maps*

Self-organizing in networks is one of the most fascinating topics in the neural network field. Such networks can learn to detect regularities and correlations in their input and adapt their future responses to that input accordingly. The

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neurons of competitive networks learn to recognize groups of similar input vectors. Self-organizing maps learn to recognize groups of similar input vectors in such a way that neurons physically near each other in the neuron layer respond to similar input vectors.

Self-organizing feature maps (SOFM) learn to classify input vectors according to how they are grouped in the input space. They differ from competitive layers in that neighboring neurons in the self-organizing map learn to recognizeneighboring sections of the input space. Thus, self-organizing maps learn both the distribution (as do competitive layers) and topology of the input vectors they are trained on. The neurons in the layer of an SOFM are arranged originally in physical positions according to a topology function

VII. CONCLUSION AND FUTURE WORK

This paper reports a Detailed Survey on Disease Diagnosis Using Different Neural Network Architecture. From The Survey it has been found that Multilayer Perceptron Neural Network (MLP) is the best architecture for Kidney Disease Diagnosis. In future, the Neural Network in this system will accept 14 clinical features as input and it will trained using Back-Propagation algorithm to predict that there will be a presence or absence of Kidney Disease in the patient with highest accuracy comparative to other systems. The accuracy thus obtained with this system will shows that it is better and efficient than other systems.

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BIOGRAPHY

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