

A Review on Neural Network Methodology for Diagnosis of Kidney Stone

Sneha A Mane¹, S R Chougule²

¹M. E E & TC, Bharati Vidyapeet's College of Engg, Kolhapur, Shivaji University, Kolhapur, Maharashtra, India

²The Principal, Bharati Vidyapeet's College of Engg, Kolhapur, Shivaji University, Kolhapur, Maharashtra, India

Abstract: *Computerized Kidney Disease Detector is a system that detects abnormalities in kidney and gives a diagnosis of potential diseases. The system takes ultrasound images, blood test results from hospitals and laboratories. The system analyses inputted data and in turn give a highly accurate diagnosis. This system assists the medical staff in their diagnosis and allows them to save time in detecting small defects in the kidney.*

Keywords: Kidney Stone, Neural network, Radial basis function, learning vector quantization, Multilayer back propagation

1. Introduction

Artificial Neural Networks (ANN) is a method applied to problems where algorithmic and symbolic approaches are not well suited. ANN's are inspired by present knowledge of biological nervous systems. Artificial neural network are models inspired by central nervous systems particularly the brain that are capable of machine learning and recognition of pattern. They are usually presented as systems of interconnected "neurons" that can compute values from inputs by feeding information through the network. An artificial neuron is a computational model inspired in the natural neurons that receive signals through synapses located on the dendrites or membrane of the neuron. In case the received signals are strong, the neuron is activated and emits a signal through the axon. This signal might be sent to another synapse, and might activate other neurons. ANN is used in medical field for diagnosis kidney stone disease, thyroid diagnosis, breast cancer etc. An ANN is designed using a building blocks and topology of a basic structure, where weights are adjusted in a systematic manner using learning laws [10].

A kidney stone is known as renal calculus. They typically leave the body by passage in the urine stream and are passed without causing symptoms. When the stones grow to a size of 3 mm, they cause obstruction of the ureter leading distension and dilation of renal pelvis, calyces, spasm of the ureter leading to pain in flank, lower abdomen, nausea, vomiting, fever, blood in the urine, pus in the urine, and painful urination. [14].

The information obtained from the history, physical examination, urinalysis, and radiographic studies are used for detection purpose. Ultrasound image and blood tests may also aid in the diagnosis. Ultrasound image can sometimes be useful, as it gives details about the presence of hydronephrosis, suggesting the stone is blocking the outflow of urine. Advantage of ultrasonography includes its low cost and absence of radiation exposure. Ultrasound imaging is better for detecting stones where X-rays or CT scans are discouraged. The tool used for simulation is MATLAB where separate toolbox is available for global optimization, communication, DSP system, data acquisition, image

processing, signal processing and many more. Among all these Neural Network Toolbox is used for training the system.

2. Literature Review

Koushal Kumar Abhishek diagnoses kidney stone disease by using three different neural network algorithms which have different architecture and characteristics. The aim of his work is 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 [1].

Tijjani and Sani provide an overview of the ANN based approaches to predicting kidney problem through comparing mental behavior of the patient using matlab software [2].

Hafizah, Supriyanto, and Yunus extracted a feature of kidney from ultrasound image based on intensity histogram [3].

Koizumi.N et al diagnosed kidney stone tracking for a non-invasive ultrasound the agnostic system propose a non-invasive ultrasound the agnostic system that tracks movement in an affected area by irradiating the area with high intensity focused ultrasound [8].

Shukla A. et al presented a Knowledge Based Approach for Diagnosis of Breast cancer where a novel approach to simulate a Breast cancer using ANN and apply three neural networks algorithms BPA, RBF and LVQ on the disease and find best model for diagnosis. [5].

Rouhani M et al. Presented comparison of several ANN architecture for Thyroid Disease. The performance of each architecture is studied, and the best method is selected for each of classification tasks. [4].

Duryeal A.P. et al. Presented a paper on Optimization of Histotripsy for Kidney Stone Erosion Histotripsy where fractionation of tissue structures are utilized, focused pulsed-ultrasound to direct the activity of a cavitation bubble cloud [7]. Mitri F.G. wrote on Vibro-acoustography imaging of kidney stones modality sensitive to stiffness and free from

speckle and possesses some advantages over conventional ultrasound imaging in terms of image quality [6].

G.Madhurambal, N.Prabha presented on Epidemiology of Urinary Stone that documented the urinary stone disease by analyzing the case histories of different sex, occupation and age [14].

3. Training Algorithms

3.1 Radial basis Function

A radial basis function (RBF) is a two layer feed forward network whose hidden layer uses a Gaussian function. The training process is very fast and also provides good interpolation networks. In this network first the weights from the hidden layer is determined and then the weights of hidden layer to output layer. The output of hidden layer i.e. transfer function is inversely proportional to distance from center of the neuron.

3.2 Learning Vector Quantization

The learning vector quantization uses the idea of data compression or dimensionality reduction. It is a supervised learning that can be used when the input data is labeled. It is used for pattern classification problem. In this first step is feature selection following classification of feature depending on the class. LVQ uses first competitive layer and second linear layer. Competitive layer is used to classify the input vectors and linear layer is used to transform the classes into target.

3.3 Multilayer Perceptron with BPA

A multilayer perceptron is a feed forward ANN model that maps sets of input data onto a set of appropriate output. Widely applied learning algorithm for multilayer perceptron in neural networks is back propagation which employs gradient descent by minimizing squared error between the network output values and desired values. These error signals calculate the weight updates that represent knowledge learnt in the networks. The performance of this algorithm can be improved by adding a momentum term [12].

4. Proposed Methodology

4.1 Diagnosis using Blood Report

In this method the data in the form of blood reports of various persons having kidney stone is obtained for various hospitals, laboratories. The report contains 5 attributes and each attribute has a specific range and weight. As shown in Table 1.

Table 1: Blood Report

Attributes	Weight	Range
Lymphocytes	30	20-50%
Monocytes	1	1-6%
Neutrophil	2	1-4%
S.Creatinine	61	50-70%
Eosinophis	3	4-10%

The dataset used for paper are 5 instances and each having 7 attributes such as age, sex, Lymphocytes Monocytes, Neutrophil, S.Creatinine, and Eosinophis.

Table 2: Dataset for kidney stone

AGE	SEX	LYMP	MONO	NEUTR	S.CREAT	EOSINO
48	F	YES	NO	YES	NO	YES
40	M	NO	YES	YES	YES	NO
51	F	NO	NO	YES	YES	YES
23	M	NO	YES	NO	NO	YES
57	F	YES	YES	NO	YES	NO

In above table, 5 attributes are used for detection purpose. In 5 attributes two values are used YES and NO. If patient report of respective attribute is in the range as discussed in table 1. then the person suffering from kidney stone will have that respective attribute YES, otherwise it contains NO. The simulation shows the result of items for easier analysis in the form of correctly classified and incorrectly classified instances. It will show the performance curve and time required for each type of training.

4.2 Diagnosis using ultrasound image

An ultrasound image sample of different kidney stone patient will be used from the medical lab and analyzed. Further the image will be send for preprocessing. In preprocessing, image is cropped as per Region of Interest by deleting and removing the complicated background. After cropping, the kidney contour detection is done. The image obtained is converted to indexed image. The indexed image is classified in the range. After indexing the index number is assigned to ANN where a network object is created and initialized using MATLAB Neural Network Toolbox. The network is trained where the ANN is presented with binary output data finally, comparison will be done from output of the network with training data and validation data, the detection of kidney stone disease done. The overall process is as shown in figure below.

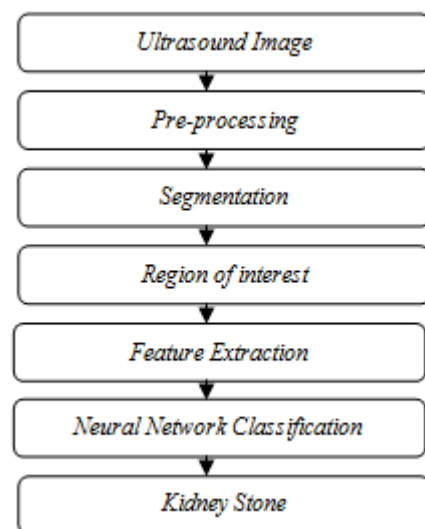


Figure 1: Design flow chart

5. Conclusion

In this paper we have proposed methodology for kidney stone diagnosis using neural network. Early detection of kidney stone is the best cure. From this, we can say that

computerized kidney stone detector will provide early and accurate detection of kidney stone.

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Author Profile



Sneha Mane was born in India and has obtained her B. E degree in Electronics Engineering from Shivaji University, Kolhapur, Maharashtra, India in 2008. Presently, she is a P.G student of E & TC in Shivaji University, Kolhapur. Prior to that, she had completed her Diploma in Electrical Engineering from Government Polytechnic, Kolhapur. Her current work is in Artificial Neural Networks and its use in medical field.