

# Neural Network for Kidney Stone Detection

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**Abstract:** *Kidney stone detector proves to be a major challenge for detecting the kidney stone disease. In this paper, two neural network algorithms viz Radial basis function and Learning vector quantization are used for diagnosis purpose Also a comparison is made between the two algorithms using MATLAB software. The main purpose is to find the best tool for medical diagnosis to reduce diagnosis time and increase efficiency with accuracy*

**Keywords:** Kidney Stone, Neural network, Radial basis function, learning vector quantization, error.

## 1. Introduction

Kidney stone is a solid piece of material formed due to minerals in urine. These stones are formed by combination of genetic and environmental factors. It is also caused due to overweight, certain foods, some medication and not drinking enough of water. Kidney stone affects racial, cultural and geographical group.

Many methods are used for diagnosing this kidney stone such as blood test, urine test, scanning. Scanning also differs in CT scan, Ultrasound scan and Doppler scan.

Now days a field of automation came into existence which also being used in medical field. Rather many common problems rose due to automatic diagnosis such as use of accurate and correct result and also use of proper algorithms. Medical diagnosis process is complex and fuzzy by nature. Among all methods soft computing method called as neural network proves advantages as it will diagnosis the disease by first learning and then detecting on partial basis [8].

In this paper two neural network algorithms i.e radial basis function and learning vector quantization are used for detecting a kidney stone. Firstly two algorithms are used for training the data. 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 tool used for simulation is MATLAB .In that separate toolbox are available for global optimization, communication, DSP system, data acquisition, image processing, signal processing and many more. Among all this

a separate toolbox called Neural Network Toolbox is used for training the system.

## 2. Literature Review

Koushal Kumar Abhishek (2012) diagnosed kidney stone disease by using three different neural network algorithms which have different architecture and characteristics. The aim of this 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].

Shukla A. et al (2009) presents Knowledge Based Approach for Diagnosis of Breast cancer this paper presents a novel approach to simulate a Knowledge Based System for diagnosis of Breast cancer using Ann and apply three neural networks algorithms BPA, RBF and LVQ on the disease and find best model for diagnosis. [4].

Rouhani M et al. (2009) present the —Comparison of several ANN architecture RBF, GRNN, PNN, LVQ and SVM on Thyroid Disease. The performance of each architecture is studied, and the best method is selected for each of classification tasks. In this paper RBF and PNN selected best models for diagnosis [3].

Duryeal A.P. et al. (2010) presents a —Optimization of Histotripsy for Kidney Stone Erosion Histotripsy is a technique for the mechanical fractionation of tissue structures which utilizes focused pulsed-ultrasound to direct the activity of a cavitation bubble cloud [5].

## 3. Training Algorithms used for training the Network

### 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.

## 4. Dataset Description

The dataset is obtained from hospitals and various laboratories. The dataset used for this paper are 5 instances and each having 7 attributes such as age, sex, Lymphocytes Monocytes, Neutrophil, S.Creatinine, and Eosinophil.

**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 the 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 also shows the performance curve and time required for each training.

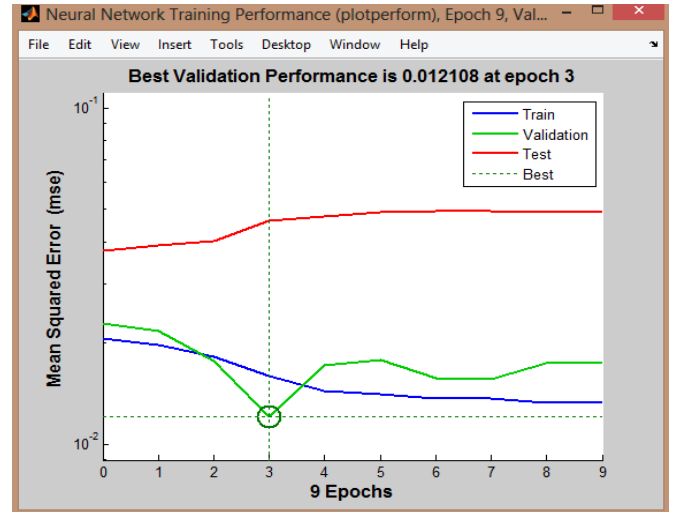
### 4.1 Diagnosis using Radial basis Function

mean absolute error = 6.6613e-17  
 mean squared error = 7.9605e-33  
 root mean squared error = 8.92216e-17  
 Percentage Correct Classification : 100.000000%  
 Percentage Incorrect Classification: 0.000000%

**Figure 1:** Command window for RBF

Fig 1 shows the results after training neural network with learning vector quantization algorithm. The result shows that it classifies the instances. Time taken to build the network is 0.0224 seconds. The **mean absolute error (MAE)** is the average of difference between predicted and actual value in all test cases [1] . The **MAE** for learning vector quantization algorithm is 6.6613e-17. The **root mean squared error** is square root of mean squared error and gives error value. The

**RMSE** for learning vector quantization algorithm is 8.92216e-17.



**Figure 2:** Performance curve for RBF

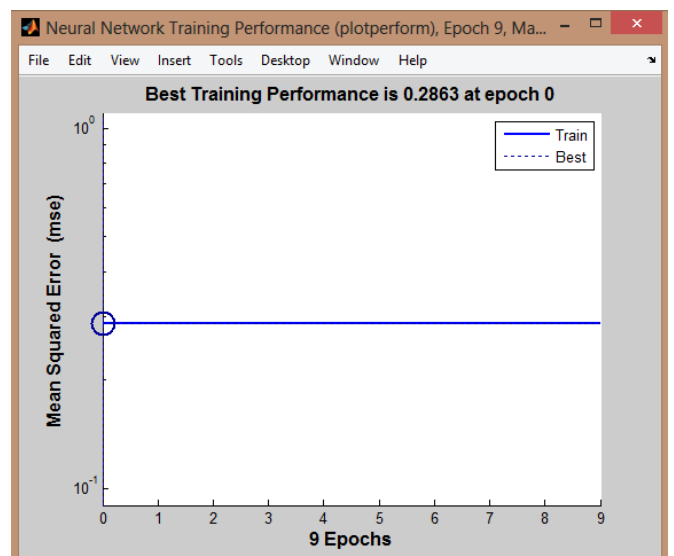
Figure 2 shows performance curve that is obtained after successful testing of network. Best training performance for RBF network obtained at 0.012108

### 4.2 Diagnosis using LVQ

mean absolute error = 0.5073  
 mean squared error = 0.2863  
 root mean squared error = 0.5350  
 Percentage Correct Classification : 100.000000%  
 Percentage Incorrect Classification: 0.000000%

**Figure 3:** Command window for LVQ

Fig 3 shows the results after training neural network with learning vector quantization algorithm. The result shows that it classifies the instances. Time taken to build the network is 0.07 seconds. The **MAE** for learning vector quantization algorithm is 0.5073.The **RMSE** for learning vector quantization algorithm is 0.5350



**Figure 4:** Performance curve for RBF

Figure 4 shows performance curve that is obtained after successful testing of network. Best training performance for LVQ network obtained is at 0.2863

## 5. Conclusion

As a conclusion, objective of my project is achieved. The best model for Radial Basis Function algorithm for kidney stone disease. It correctly classifies the datasets. Also time taken to build the model is also less as compared to learning vector quantization. The error rates are also less as compared to LVQ. The performance rate obtained for RBF is 0.0121 which good as compared to LVQ. Hence, Radial basis function (RBF) significantly improves the classification technique for medical use.

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## Author Profile



**Ms Sneha A Mane** was born in INDIA and has obtained B.E degree in Electronics Engineering from Shivaji University, Kolhapur, Maharashtra, India in 2008. Presently, she is PG student of ETC 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 Network and its use in Medical field.