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Detection of Gallbladder Stone Using Learning Vector Quantization Neural Network

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***Abstract*- Ultrasound has been usually used to diagnose the gallbladder stone. Ultrasound is easy to apply for diagnosis. In this study, a biomedical study based on Learning Vector Quantization Neural Network (LVQNN) has been developed in order to classify gallbladder stone. There is also detail description of patient's symptoms. The main model goal is to identify patients with gallstone. MATLAB tool is used to apply the LVQ network to diagnosis the problem. Two methods are used for this work. First is clustering and second is classification. In clustering all the patients are separated into two clusters. One for affected and second for not affected. Then classification is done to categorize the patients having disease and normal patients. For classification data is collected from different laboratories. The data is alienated into input and target data. Target data has two values 1 and 2. 1 will show the effected patients and 2 will show the healthy patients. LVQ is already used for diagnosis for other disease. It gives the very accurate result for diagnosis of gallbladder stone.**

Keyword: Artificial neural Network, Medical Diagnosis, LVQNN, MATLAB tool, Medical Data.

I INTRODUCTION

Artificial neural networks provide a commanding tool to help doctors to analyze and make sense of complex clinical data across a wide range of medical applications. Artificial Neural Network is a calculation system, having been developed through motivation from the structure, as well as from the learning characteristics of neural cells. ANN is a network of highly interconnecting dealing out elements operating in equivalent. These elements are inspired by biological nervous system. As in nature, the connections between elements largely determine the network function. A group of processing elements is called a layer in the network. The first layer is the input layer and the last layer is the output. Between the input and the output layer, there may be additional layer of units, called hidden layer. [8] Figure 1 shows a neural network. We can train a neural network to perform a particular function.

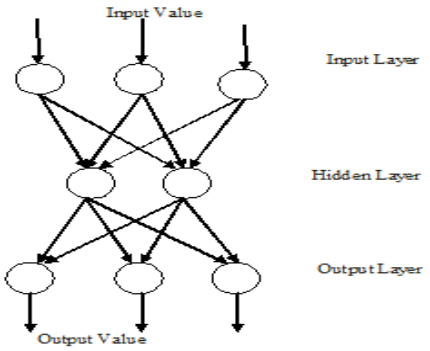


Figure 1: A Neural Network

Medical Diagnosis using Artificial Neural Network is currently a very active research area in medical and it is possible that it can be used in biomedical system in coming years. Neural Network learnt by examples so the detail of how to recognize the disease is not needed. A diagnosis is based on laboratory reports and test results. A proper diagnosis requires an examination of signs and symptoms. To classify the gallbladder stone, the symptoms of the disease are taken. According to these symptoms patients' medical data is collected from laboratories.

Gallbladder is an organism in human body. Stone in the gallbladder is affected the digestive system and hormonal system. The normal symptoms of gallstone are acute pain in backbone, tiredness, headache, immediate sweating etc. Gallbladder is an organism of human body. Many efforts are made to control it. To make the patient healthy again, it is important to find the stage of the disease in which patient is located. Gallstones form when the liquid bile hardens and changes to hard pieces of stone-like material which then can block.

Many researches had proposed medical diagnosis models on neural networks.

Detection of carotid artery was realized by learning vector quantization and power spectral density. In this study, a biomedical system based on LVQNN has been developed in order to classify the internal carotid artery Doppler signals. The system is composed of feature extraction and classification parts. [1]

Artificial intelligence approaches to medical diagnosis. The goal of this paper is the diagnosis of hematuria, blood in urine, is studied from the point of view of identifying crucial structure and process in medical diagnosis. [2]

Knowledge Based Approach for Diagnosis of Breast Cancer. This paper presents a novel approach to create a Knowledge Based System for diagnosis of Breast Cancer.

Artificial Neural Networks and Neuro Fuzzy Systems tools are used. The feed-forward neural network has been trained using three ANN algorithms, the Back propagation algorithm (BPA), the Radial Basis Function (RBF) Networks and the Learning Vector Quantization (LVQ) Networks; and also by Adaptive Neuro Fuzzy Inference System (ANFIS). The simulation has been developed using MATLAB. [3]

Predict the Heart Disease Medical Prescription Using Radial Basis Function. In this paper the author used Radial Basis Function to predict the medical prescription of heart disease. The radial basis function is applied to heart disease data for the diagnosis of heart disease. Result shows that RBF can be successfully used for the diagnosis to prescribing the medicines for heart disease. [4]

Input and Data Selection Applied to Heart Disease Diagnosis to present an application of data and input selection to a heart disease diagnosis problem. In this LVQ is used to diagnosis the problem. [5]

Artificial Neural Networks for Diagnosis of Hepatitis Disease. In this paper the author shows that neural networks have become a very important method in the field of medical diagnostic. In this the author used feed forward neural network and a hybrid network. He compares these two networks. The result shows that the hybrid network can be successfully used for diagnosis of hepatitis. [6]

II TECHNIQUE USED FOR GALLBLADDER STONE DIAGNOSIS IN THIS PAPER

Learning vector Quantization is a well known algorithm that deals with the problem of selecting prototypes. LVQ NN is a nearest neighbor pattern classifier based on competitive learning. A LVQ NN has a competitive layer and a linear output layer. The linear layer transforms the classes of competitive layer into user defined classifications. The competitive layer learns to classify input vectors. The linear layer transforms the competitive layers' classes into target classifications. 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. The competitive layer can learn up to S^1 subclasses. These are combined by the linear layer to form S^2 target classes. To create a LVQ network n-by-2 matrix of minimum and maximum values for n input elements is defined. In the network there are number of first layer hidden neurons, element vector of typical class percentages, learning rate and learning function is defined.LVQ NN structure has been successfully used in the tasks of diagnosis of various diseases. [7] The architecture of LVQ neural network is shown in the figure 2.

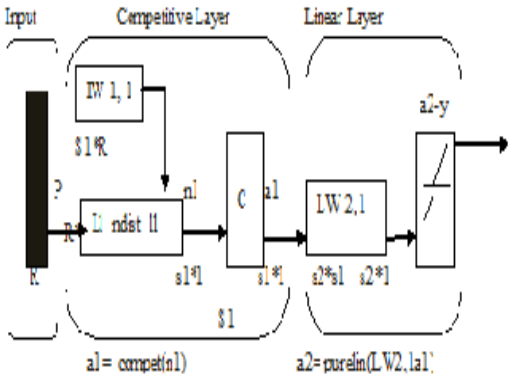


Figure 2: Architecture of LVQ

Where r= number of elements in input vector
S1= number of competitive neurons
S2= number of linear neurons

III. RAW DATA OBTAINED

Data is obtained from patients reports. After getting the medical reports, a symptom is taken which are belongs to the disease. And scan reports are also collected from laboratories. This symptom reports and the scan report result is used for the diagnosis.

Table1: Symptoms of Patients

Symptoms	Range	Range description
Cholecystitis	0,1	0= No and 1= Yes
Bile salt	0,1,2,3	0=very less, 1= less, 2=normal, 3=more

Bile salt is the salt present in human body which helps to digest the food. Bile salts should be normal in human body. If bile salts are very less or more then there can be problem in bladder. Cholecystitis is the presence of stone in the bladder. It can only be checked by scan report. With the help of these two symptoms a doctor can estimate about the stone. These symptoms come under some range as shown in table 1. . For Cholecystitis the range is 0 and 1. 0 is for no Cholecystitis and 1 indicates the presence of Cholecystitis. For bile salt the range is from 0 to 3. 0 and 3 indicates abnormal position of the patient. If the bile salts are in the range of 0, it means the quantity of salts in the bladder is very less and if salts are in the range of 3 then salts are in large quantity which is also very harmful for human body. 1 and 2 ranges present the normal position of the patient. If the range is 1 then there may be some infaction in the bladder. 2 indicate the patient with normal and healthy bladder.

Bile salts can be checked by testing urine of the patient. So the urine examination reports of the patients are collected and the ultrasound reports of the same patients are also collected because Cholecystitis is tested by ultrasound examination of whole abdomen. This all information about the data of the symptoms is collected from the laboratories and by consulting the doctors. Now the medical data of 200 patients is collected from different laboratories. These reports are collected from laboratories as Garg Diagnostic Laboratory, Harbans Ultrasound and C.T. scan centre. The sample data of 10 patients is shown in the following table.

Table2: Data of Patients' Reports

Cholecystitis	Bile salts
0	**2**
1	**0**
1	**3**
0	**1**
1	**0**
0	**2**
1	**3**
0	**1**
1	**0**
1	**3**

IV Diagnosis using Learning Vector quantization Neural Network

In this section, we develop a process to help the doctors to diagnose the disease using LVQNN technique. Data is collected from patient's reports. This data is set in a table form. According to this patients' data classes are generated for each input value. 200 inputs i.e. 200 patients' reports, are taken for two attributes. Now LVQ is trained for this input and classes of these inputs. These classes are needed to be transformed into vector to be used as targets.

LVQ network represents the clusters of vectors as shown in the figure 3.

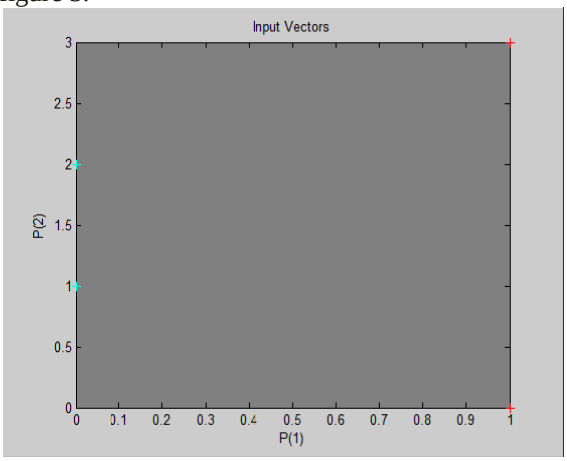


Figure 3: clustering

After making the clusters, now we able to know the number of patients come in cluster one and numbers two. In the figure a red colored sign is for cluster 1 and cyan colored signs are for cluster 2. Now classification is done to know if the new patient is affected or not that is he/she comes under cluster one or two. If the patient is effected then he will comes in clutter one i.e. 1 and if he is not effected by the disease, he will come in second cluster i.e. 2.

Now training of the network is done by first override the default number of epochs and then train the network for classification. The network is trained as shown in figure 4.

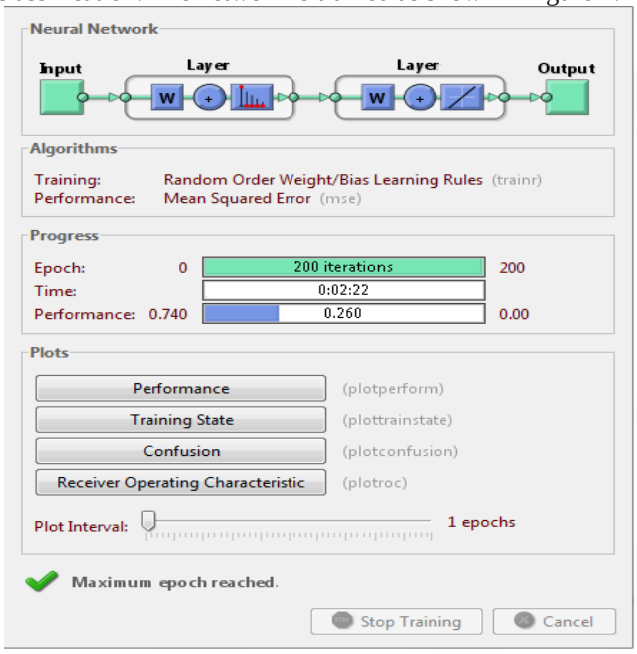
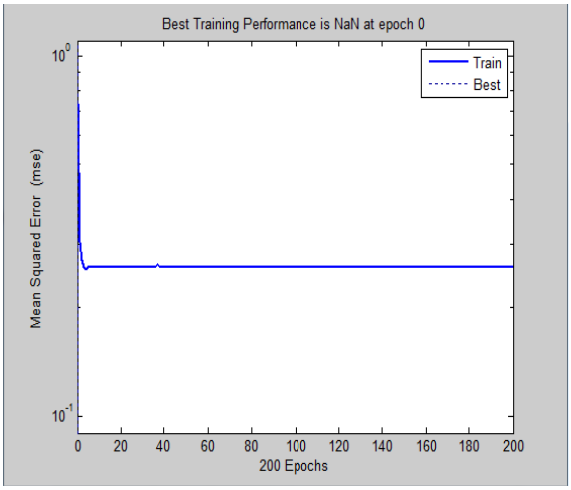


Figure 4: Training

The network is trained with 200 epochs. Figure 5 shows the best performance curve of LVQ neural network with 200 epochs.



After training of the network now we will use the LVQ network as classifier, where each neuron corresponds to a different category. In this the data of a new patient is the input. It will give the output as the cluster in which the patient comes under. If the output after the training of the network is 1 then the patient comes under first cluster means he has stone in his bladder and if the output is 2 then the patient comes under the second cluster means a healthy person.

For testing the input data of a patient is applied to the network. And it gives the accurate result. The patient's Cholecystitis range is 1 and bile salt range is 3. These symptoms are tested by the network and the patient comes under cluster 1 means he has stone in his gallbladder.

V Future Work

LVQ is used to classify the patients having gallbladder stone disease. For this the patients' medical data is collected from different laboratories. These reports are of those patients who have acute pain in their gallbladder. And then we classify these patients as effected and not effected. In the future work classification can be done to classify the patients having a particular disease from different diseased patients. This can be done by clustering. Different patients having different diseases are divided into cluster and then these clusters can be used for classification.

VI Conclusion

In this study, a biomedical system based on LVQ NN has been developed in order to classify the gallstone. LVQ NN was used to classify gallbladder. To check the accuracy of LVQ network, it is compared with other neural networks as RBF, BPA. This comparison is done by using other tool known as WEKA tool. Using this tool the accuracy of LVQ and other networks checked. And in the result LVQ shows the best accuracy as compare to other networks. LVQNN is a reasonable classifier system, and effective for classification of gallbladder stone. This classification technique can help the doctors to diagnose the disease.

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