

CHAPTER-VII

DECISION SUPPORT SYSTEM FOR CONGENITAL HEART SEPTUM DEFECT DIAGNOSIS USING NEURAL NETWORKS

7.1 Introduction

Generally Congenital Heart Septum Defect is diagnosed in two stages namely Physical Evaluation and Clinical Evaluation stages. During Physical Evaluation stage, a physician obtains the Signs and Symptoms of a patient and records the measurements like Heart Beat, Systolic B.P, and Diastolic B.P, etc. Based on these values, a physician either suspects a disease or not. If a physician suspects a disease, then only he orders for the clinical tests. Based on the resultant values of these tests only, a physician confirms the disease.

Though in the present study, individual Decision Support Systems are developed both for Physical Evaluation and Clinical Evaluation of a patient still it is difficult for a physician to take the decision based on the resultant values of Decision Support Systems. Because some clinical tests may show the abnormality of the disease and some may not show the abnormality of the disease, in which it is difficult for the physician to take the decision. Also for an inexperienced physician it takes more time to take the decision, which may cause the time delay of the diagnosis. Therefore, a Decision Support System is developed using Backpropagation Neural Network to diagnose Congenital Heart Septum Defect automatically based on the Physical (if abnormal) and

Clinical Evaluation of a patient. The Network is trained by using a Delta Learning Rule. The user friendly Decision Support Systems is designed and implemented in MATLAB 7.3 with GUI features.

7.2 Materials and Methods

Parameters Used

The parameters used in the present study are the resultant values of Decision Support System for Congenital Heart Septum Defect Diagnosis based on Signs and Symptoms, Decision Support system for Congenital Heart Septum Defect diagnosis based on ECG features, Decision Support System for Congenital Heart Septum Defect diagnosis based on Chest X-ray features and the Decision Support System for Congenital Heart Septum Defect Diagnosis based on the Echocardiography features. In this study a total number of 200 samples are used, in which each sample is having a set of 4 input parameters and one output parameter. The parameter names and the allowed values for that are described in table 7.1. In table 7.1, the parameter CHSDSSR is used to indicate the resultant value of Congenital Heart Septum Defect Diagnosis based on Signs and Symptoms, the parameter CHSDECGR is used to indicate the resultant value of Congenital Heart Septum Defect Diagnosis based on ECG features, the parameter CHSDCXRR is used to indicate the resultant value of Congenital Heart Septum Defect Diagnosis based on the Chest X-ray features and the parameter CHSDECHOR is used to indicate the resultant value of

Congenital Heart Septum Defect Diagnosis based on Echocardiography features.

#No	Attribute Name	Description	Allowed Values
1	CHSDSSR	The resultant value of Decision Support System for CHSD based on signs and symptoms	Binary
2	CHSDCXRR	The resultant value of Decision Support System for CHSD based on signs and symptoms	Binary
3	CHSDECGR	The resultant value of Decision Support System for CHSD based on signs and symptoms	Binary
4	CHSDECHOR	The resultant value of Decision Support System for CHSD based on signs and symptoms	Binary

Table 7.1: Parameter Names, Descriptions and allowed Values of DSS for CHSD Diagnosis based on the resultant values of physical and clinical tests

Method

In order to develop a Decision Support System for Congenital Heart Septum Defect Diagnosis, at first, an algorithm is developed to automatically obtain the results of both Physical Evaluation and Clinical Evaluation of a patient based on patient number. i.e the result of Congenital Heart Septum Defect Diagnosis based on Signs and Symptoms, the result of Congenital Heart Septum Defect Diagnosis based on ECG features, the result of Congenital Heart Septum Defect Diagnosis based on Chest X-ray features and the result of Congenital Heart Septum Defect Diagnosis based on Echocardiography features. Then a Backpropagation Neural Network (discussed in section 2.2.7) is built based on the extracted resultant values. The network is trained using a Delta Learning Rule. The activation function used in this model is the sigmoid

function. Once the network is trained, then it can be used to perform the diagnosis classification automatically for a new pattern. In order to make the Decision Support System user friendly it is (the front-end) designed using MATLAB 7.3 with GUI features. The Decision Support System is developed not only for the diagnosis classification, but it can also be used to store and view the diagnosis result. The architecture of a Decision Support System for Congenital Heart Septum Defect Diagnosis is shown in fig7.1.

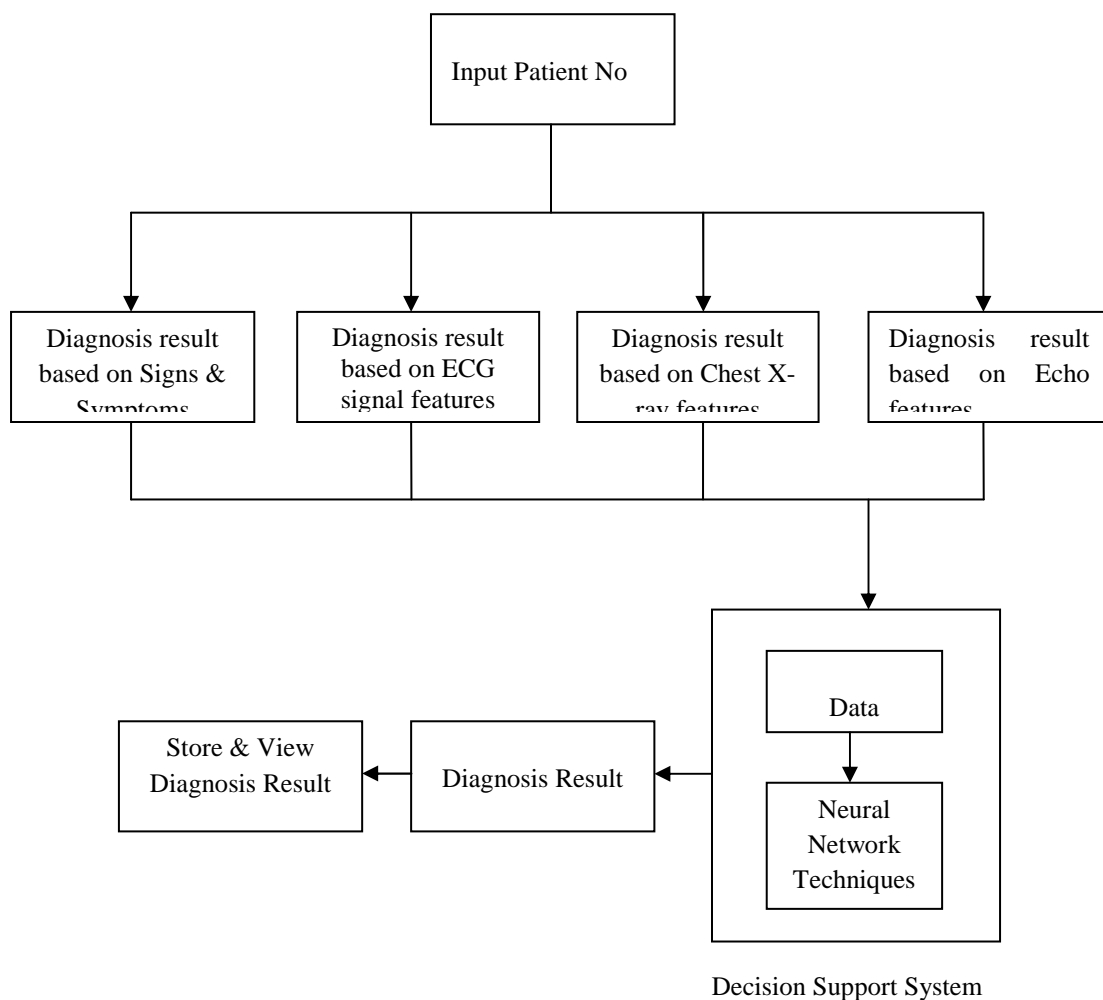


Fig 7.1: Architecture of DSS for CHSD Diagnosis

From the architecture it shows that, when a patient number is given as input by the user, the developed Decision Support System automatically extracts the diagnosis results of Congenital Heart Septum Defect Diagnosis based Signs & Symptoms, Congenital Heart Septum Defect Diagnosis based on Chest X-ray, Congenital Heart Septum Defect Diagnosis based on ECG signal, Congenital Heart Septum Defect Diagnosis based on Echocardiography, does the diagnosis classification automatically based on the extracted results and displays the final result. The developed Decision Support System also stores the diagnosis result automatically, which can be used for future reference.

7.3 Experiments and Results

Experiment:

A Decision Support System for Congenital Heart Septum Defects Diagnosis is designed and developed by using MATLAB 7.3 [Lau05][SSD05] by implementing the Backpropagation Neural Network Model. Initially a Backpropagation Neural Network is built with 4 input nodes, 1 hidden node and one output node. The network is trained using a supervised training and a Delta Learning Rule. 200 samples are used to train and test the network. Among these samples, 85% of the data are used for training and 15% of the data are used for testing purposes. Once the Network is trained using these samples, then for a new pattern it does the classification automatically. The Error performance (Mean Squared Error) of the training network is shown in fig 7.2.

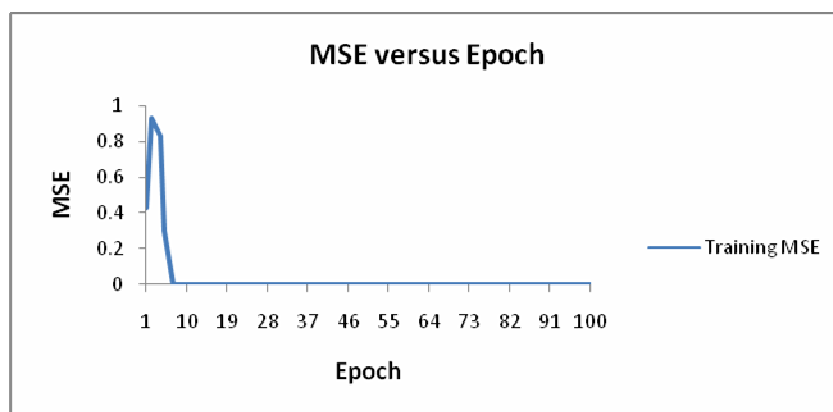


Fig 7.2: The Error Performance of a training network of DSS For CHSD physical and clinical features

The developed Decision Support System performs four types of operations, which are represented in terms of NEW, PREDICT, STORE, VIEW pushbuttons. Pushbutton NEW is used to clear the screen (for entering new patient information), the pushbutton PREDICT is used to perform the diagnosis classification and to display the result, the pushbutton STORE is used to store the patient information along with the resultant value in terms of text format and the pushbutton VIEW is used to view the stored text file.

The developed Decision Support System can be used by a physician to automatically diagnose Congenital Heart Septum Defects by entering the patient number. The developed system reduces the diagnosis time of a physician and also increases the accuracy of the diagnosis. The developed system is not only used for diagnosis, but can also be used to store and view the results of the diagnosis for future reference.

Results:

The developed Decision Support System can be tested by entering a patient number. Once the patient number is entered then the developed Decision Support System automatically extracts diagnosis resultant values of Physical and Evaluation of patients, perform the diagnosis classification and display the result when PREDICT pushbutton is pressed. The diagnosis result of a patient who suffers with Congenital Heart Septum Defect through the developed Decision Support System is shown in fig 7.3. The developed Decision Support System gave an accuracy of 100%, which is shown fig 7.4. The classification result of the experiment in terms of the confusion matrix is shown in table 7.2.

CHDCHD

Decision Support System for Congenital Heart Septum Defect diagnosis

CHSD diagnosis

Patient No 100 Consulting Date 30-Apr-2011

DSS for CHSD diagnosis

Result of Signs & Symptoms diagnosis Abnormal

Result of Chest X-ray diagnosis Normal

Result of ECG diagnosis Abnormal

Result of Echocardiography diagnosis Abnormal

Predicted Result Abnormal

Manipulations

NEW

PREDICT

STORE

VIEW

Figure 7.3: Result obtained through the Decision Support System

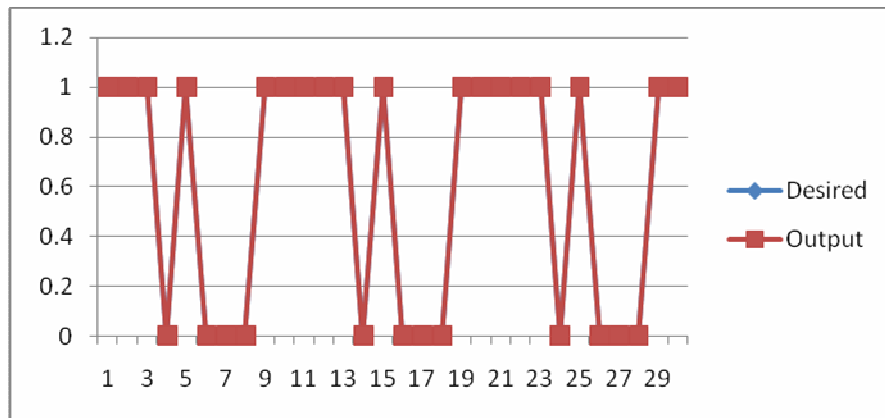


Fig 7.4: Classification accuracy of the Decision Support System for CHSD physical and clinical evaluations

Output / Desired	<i>0</i>	<i>1</i>
<i>0</i>	12	0
<i>1</i>	0	18

Table 7.2: Confusion Matrix of DSS for CHSD Diagnosis based on physical and clinical evaluations classification

7.4 Conclusion

Because the Congenital Heart Septum Defect diagnosis is multi stage test based diagnosis, it is difficult for a physician to take the decision based on the resultant values of the tests. Therefore, the developed Decision Support System can be used to automatically diagnose the Congenital Heart Septum Defect based on the resultant values of the diagnostic tests which are obtained automatically. The developed Decision Support System reduces the diagnosis time and also increases the accuracy of the diagnosis.