CHAPTER-III
DECISION SUPPORT SYSTEM FOR CONGENITAL HEART SEPTUM DEFECT DIAGNOSIS BASED ON SIGNS AND SYMPTOMS USING NEURAL NETWORKS

3.1 Introduction

Congenital Heart Septum Defects are basically diagnosed in two stages. These stages are Physical Evaluation and Clinical Evaluation of a patient. During Physical Evaluation stage, a physician obtains the Signs, Symptoms and also the measurements like Systolic Blood Pleasure, Diastolic Blood Pleasure and Heart Beat Rate etc., of a patient. The patient is suspected based on these Signs, Symptoms and Measurements only. During the Physical Evaluation if the physician suspects the disease then the patient is advised for Clinical Evaluation.

In some situations, a physician may fail to suspect a disease during the first stage because of not being a specialist or inexperience with the previous cases and there is a chance for taking wrong decision. If the physician takes a wrong decision by not suspecting a disease at the first stage then the physician never orders for the second test, where a disease can be detected. In this case, even though a patient has a defect and it won't be detected, the patient enters into the severe condition. Also, if physician takes a wrong decision by suspecting a patient at the first stage and orders for the second stage tests then

though the patient doesn’t has a defect, the patient should be clinically tested which causes for more time to know the results and is a cost effective.

Therefore in this module, to overcome the above said drawbacks, a Decision Support System using Backpropagation Neural Network is proposed for automatic diagnosis of Congenital Heart Septum Defects based on Signs and Symptoms. The Backpropagation Neural Network used in this study is a Multilayered Feed Forward Neural Network, which is trained by a Delta Learning Rule. The dataset used in this study are the Signs, Symptoms and Measurements of a patient. The proposed Decision Support System is designed and developed in MATLAB 7.3 with GUI features.

3.2 Materials and Methods

Parameters Used

The data required for this module is collected from the hospitals. The parameters that are used to perform Congenital Heart Septum Defect Diagnosis classification is the Signs, Symptoms and Measurements that are obtained from the patients during Physical Evaluation[COL92]. In the present study, a total number of 200 samples are used. Each sample is having a set of 36 input parameters and one output parameter. The input parameters represent the obtained Physical Evaluation features and the output parameter represents the diagnosis classification result in terms of abnormal or normal. Since the collected data may contain both continuous and binary data, a Linear Data

Scaling method [SSD05] is used to normalize the collected data. The parameter names, description and the allowed values for that are described in table 3.1.

#No	Attribute Name	Description	Allowed Values
1	Age	Patient's Age	Continuous
2	Gender	Patient's Gender	Binary
3	Fatigue	Feeling very tiredness due to overflow of blood	Binary
4	Shortness of Breath	Unable to take a normal breath	Binary
5	Headache	A pain in the head or neck due to defect in the heart	Binary
6	Sweating	Due to tiredness (if a defect present in heart)	Binary
7	Cold	Symptom of Chest Infection	Binary
8	Problem of Feeding	Children can face problem while feeding due to shortness of breath	Binary
9	Less Weight	If a defect present in the heart, children loss normal weight	Binary
10	Easily Tiring	Getting tiredness during exercise due to defect in the heart	Binary
11	Cough	Comes due to chest infection (which brings up phlegm)	Binary
12	Chest Pain	Getting pain in the chest due to abnormal flow of blood	Binary
13	Clubbing	The proliferation of soft tissue around the ends of fingers.	Binary
14	Hypertension	Due to high blood pressure (which occurs due to the mixing of blood)	Binary
15	Palpitations	Periods of rapid and irregular heartbeats (Due to overflow of blood)	Binary
16	Fever	Infection caused by bacteria	Binary
17	Dyspnea	Shortness of breath	Binary
18	Dizziness	Due to low blood pressure, cardiac arrhythmias	Binary
19	Vomits	Common symptoms for Acute Myocardial Infection (AMI)	Binary
20	Diarrhea	Symptom for a Congenital Heart Defect	Binary
21	Chest Infection	Is a bacterial or viral infection of the airways leading down into the lungs	Binary
22	Syncope	Is a sudden or temporary loss of consciousness or Fainting	Binary
23	Trauma	Impaired blood flow to the lungs	Binary

24	Build up of blood and fluid in lungs feet ankles and legs	Which occur as symptom of a defect in the heart.	Binary
25	Systolic B.P	Maximum pressure in the arteries during the cardiac cycles, which occurs when the heart contacts or beats to pump blood	Continuous
26	Diastolic B.P	Refers to the pressure that is exerted on the walls of the various arteries around the body in between heart beat when the heart is released	Continuous
27	Heart Beat	A cardiac cycle of the heart	Continuous
28	Cyanosis	Is a severe condition indicates lack of oxygen in the blood supply causes a bluish tint to the skin, lips and finger nails	Binary
29	Edema	Swelling of organs or body tissue	Binary
30	Thrill	Chest wall vibrations of sufficient intensity to be 0 or 1 recognized by tactile sensation	Binary
31	Cardiac Failure	Is a condition in which the heart function as a pump to deliver oxygen rich blood to the body is inadequate to meet the body's need	Binary
32	Regurgitation	Is characterized by diastolic reflex of blood from the aorta into the left ventricle	Binary
33	Systolic Murmur	Heard when the heart is squeezing and pumping blood out of the heart	Binary
34	Diastolic Murmur	Heard when the heart is relaxing and filling with blood	Binary
35	Both Murmurs	Heard during the entire heartbeat signs of a heart defect	Binary
36	Anemia	Anemia is a common in acquired heart failures and affects prognosis	Binary

Table 3.1: Attribute Names, Description and their Allowed Values of DSS for CHSD Diagnosis based on Signs and Symptoms

Method

In this module, to develop a Decision Support System for Congenital Heart Septum Defect Diagnosis based on Signs and Symptoms, initially a Backpropgation Neural Network (discussed in section 2.2.7) is built by taking input parameters of the Congenital Heart Septum Defects data (Signs & Symptoms). The network is trained using a Delta Learning Rule. The dataset used to train the network is the Congenital Heart Septum Defect database, which are designed based on the Signs, Symptoms and Measurements of a

patient. 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. The architecture of a Decision Support System for Congenital Heart Septum Defect diagnosis based on Signs and Symptoms is shown in fig 3.1.

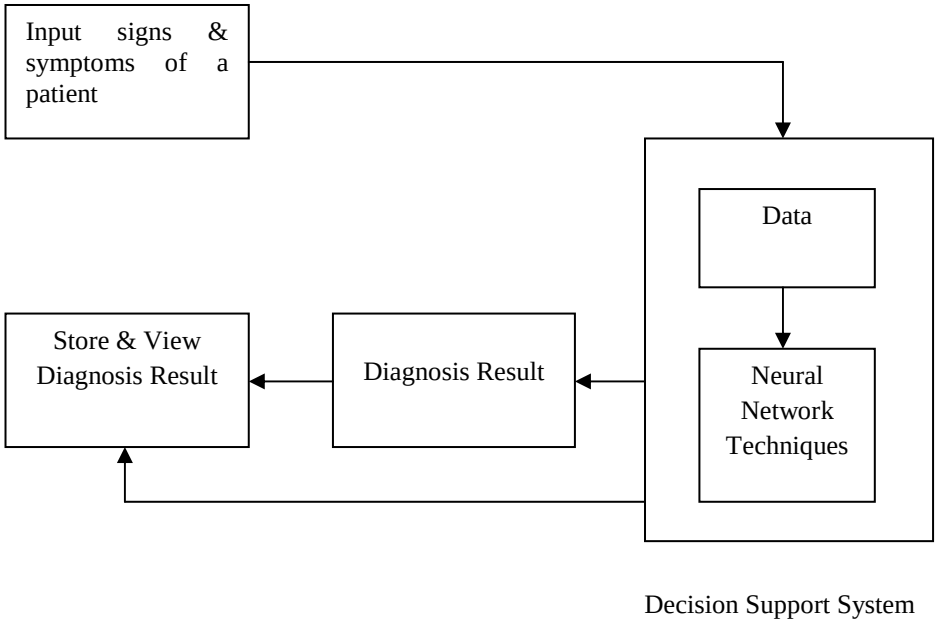

Fig 3.1: Architecture of DSS for CHSD Diagnosis based on Signs and Symptoms

The architecture shows that when the Signs, Symptoms and Measurements of a patient are entered by the user, the developed Decision Support System does the diagnosis classification automatically and displays the result. In addition to the diagnosis, the proposed system also stores and retrieves the resultant values for future reference. The user friendly Decision Support System is designed and implemented in MATLAB 7.3 with GUI features.

3.3 Experiments and Results

Experiment:

An user friendly Decision Support System for Congenital Heart Septum Defects Diagnosis based on Signs and Symptoms is designed by using MATLAB 7.3 with GUI feature to implement the Backpropagation Neural Network Model [Lau05][SSD05]. Initially, a Backpropagation Neural Network is built with 36 input nodes, 10 hidden nodes and one output node. The supervised Network is trained using 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 it does the classification automatically for a new pattern.

The following figures show the results of the present experiment. Fig 3.2 shows the Error performance (Mean Squared Error) of the training network. Also it shows that the MSE value is decreased as the number of epoch increases. A least MSE value for the present experiment is 0.016.

The developed Decision Support System performs four types of operations, which are represented in terms of NEW, PREDICT, STORE, VIEW pushbuttons shown in. Pushbutton NEW is used to clear the screen (for entering new patient information), the pushbutton PREDICT is used to automatically perform Congenital Heart Septum Defect Diagnosis classification (the trained

Backpropagation Neural Network is used to perform the diagnosis classification) and to display the result, the pushbutton STORE is used to store the diagnosis resultant value in terms of text format and the pushbutton VIEW is used to view the stored text file.

The Decision Support System can be used by a physician to automatically diagnose Congenital Heart Septum Defects by entering the basic information, Signs, Symptoms and Measurements of a patient. 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 instead it can also be used to store and view the results of the diagnosis for future reference.

Results:

The Decision Support System can be tested by entering the basic information Signs, Symptoms and Measurements of a patient. Once these information are entered, then the PREDICT button can be pressed to automatically display the diagnosis result. The results obtained through the developed system for an abnormal person who has Congenital Septum Defect and for a normal person are shown in figures fig 3.3 and fig 3.4 respectively. In order to store the diagnosis result in a text format, the pushbutton STORE is pressed and to view the stored data text file, the pushbutton VIEW is pressed. The developed Decision Support System gave an accuracy of 86.6%, which is

shown fig 3.5. The classification result of the present experiment in terms of the confusion matrix is shown in table 3.2.

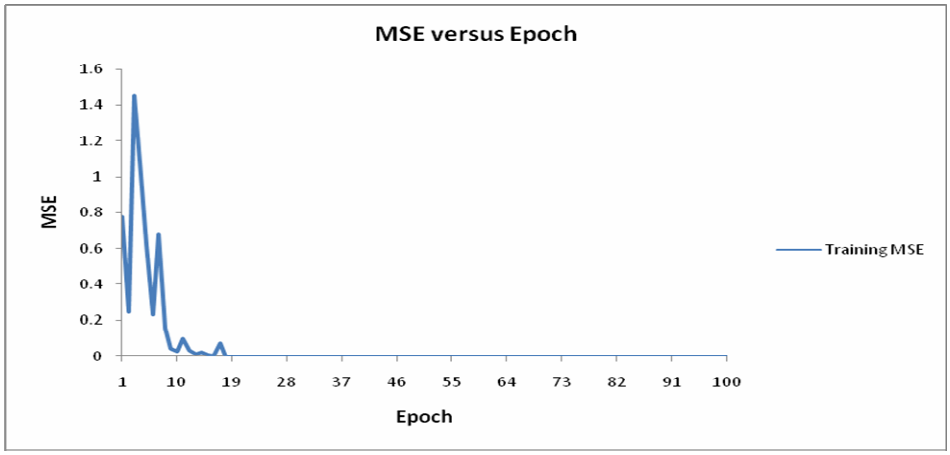

Fig 3.2: The Error Performance of a training network of DSS for CHSD Diagnosis based on Signs and Symptoms

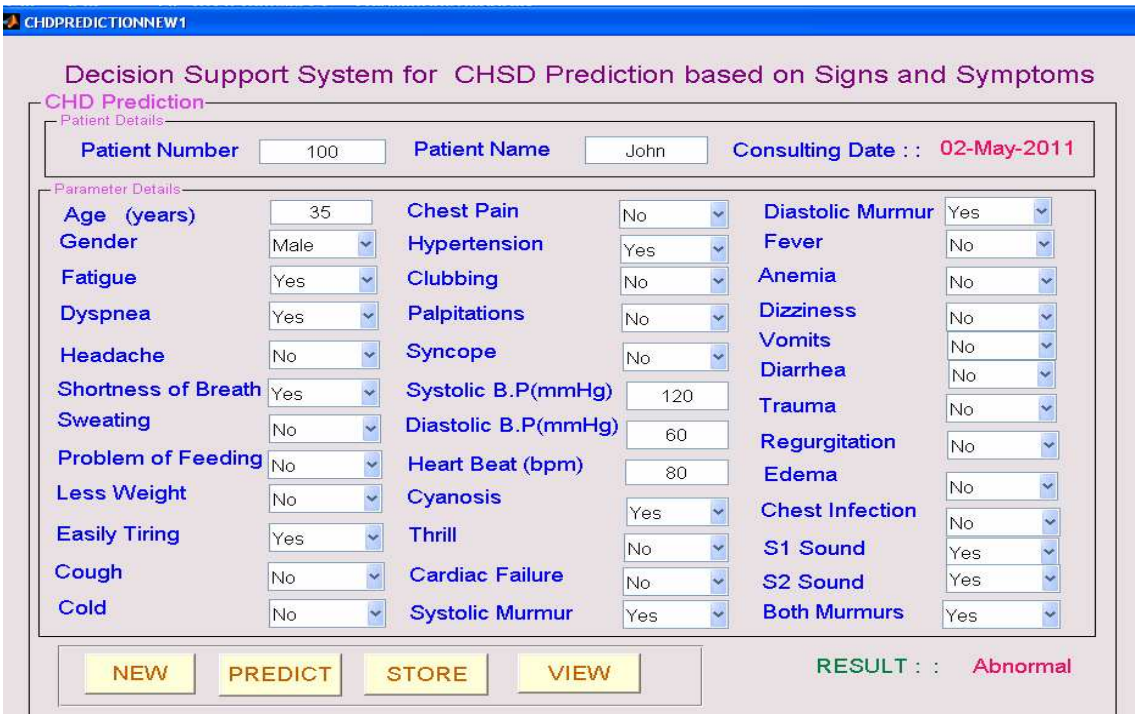

Fig 3.3: The Diagnosis result of an abnormal person using developed DSS for CHSD Diagnosis based on Sings and Symptoms

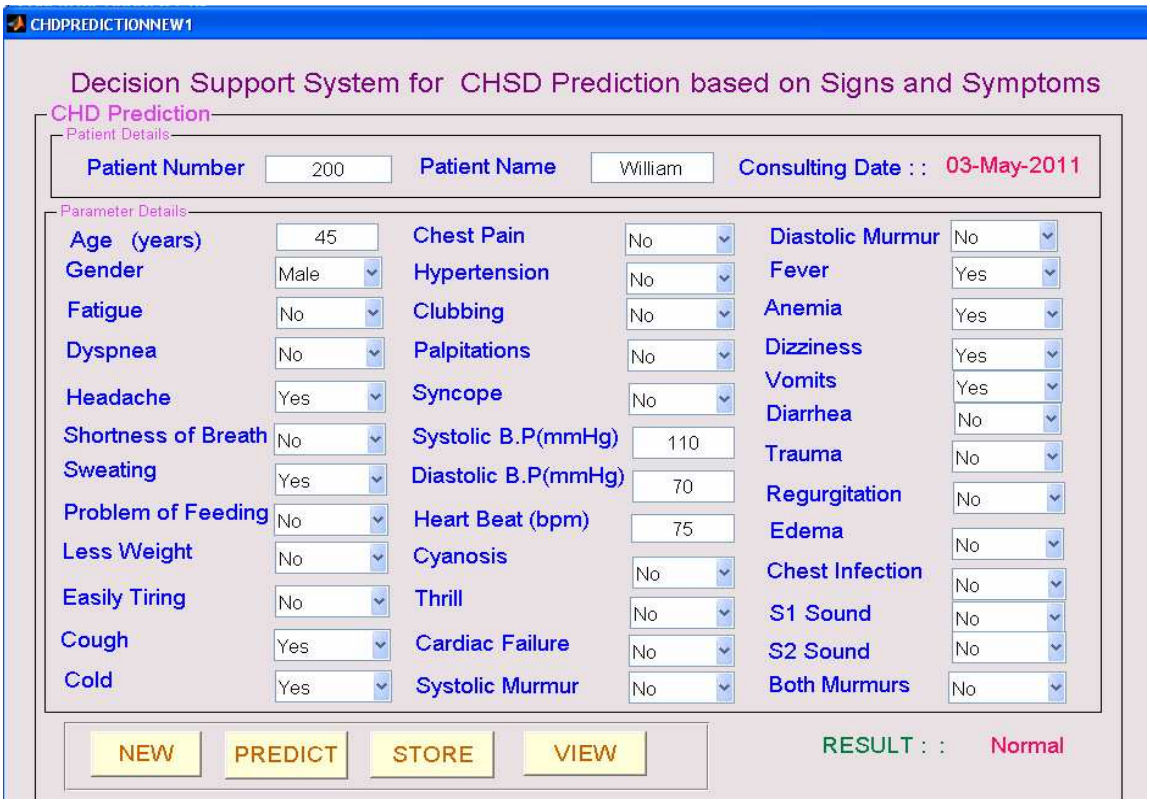

Fig 3.4: The Diagnosis result of a normal person using developed DSS for CHSD Diagnosis based Signs and Symptoms

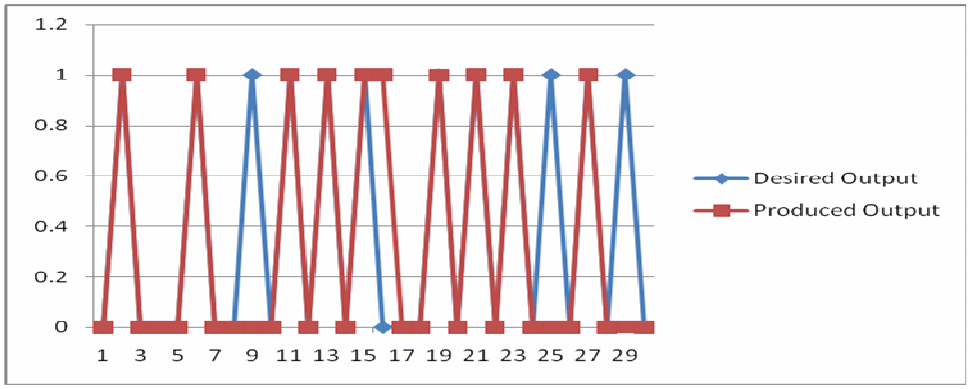

Fig 3.5: A chart representing the classification accuracy of the DSS for CHSD Diagnosis based on Signs and Symptoms classification

Output / Desired	***0***	***1***
0	17	3
1	1	9

Table 3.2: Confusion Matrix of DSS for CHSDDiagnosis based on Signs and Symptoms classification

From the present experiment, it shows that if a patient has any of the Symptoms like Dyspnea, Shortness of Breath, Chest Pain and Cyanosis then a patient gets suspected. Also it shows that the percentage of suspecting Congenital Heart Septum Defects will be more if a patient has any murmurs like systolic or diastolic or both murmurs and the sounds of S1, S2. Therefore, the present experiment gives more accurate results once the Sign, Symptoms and Measurements of a patient are clearly known. Since the Solutions of Neural Networks will not depend on the algorithmic solutions, it gave accurate results when comparing to manual diagnosis.

3.4 Conclusion

As the population increases day by day, the number of children suffering with Congenital Heart Septum Defects is also in rise. This increases the unavailability of physicians and also increases the inaccuracy of the diagnosis. Therefore, the developed Decision Support System can be used for automatic diagnosis of Congenital Heart Septum Defect based on Signs, Symptoms and Measurements. The developed Decision Support System speeds up diagnosis process, improves the accuracy of the diagnosis and reduces the cost without loss of diagnostic performance. The Decision Support System also decreases the number of diagnostic tests and predicts the disease at an early stage of the disease. Therefore, the present module gives a better performance when comparing with the manual diagnosis.