INTERNATIONAL JOURNAL FOR TRENDS IN ENGINEERING & TECHNOLOGY
VOLUME 34 ISSUE 1 – OCTOBER 2018 - ISSN: 2349 – 9303

Detection and Classification of Heart Murmurs Using Neural Network

[1]Dr.Mary Jansi Ran
[1]Professor,
Sri Ramakrishna Engineering College
jansirine@srec.ac.in

[2]Prakash.M.R,G,[2]Praveen.Y,
[2]Nandakumar.S
[2]UG Scholars,Sri Ramakrishna Engineering College
prakash.1402137@srec.ac.in,

***Abstract*—**Auscultation is the best method for detecting the cardiovascular problem, which is theone of the reason of people death in the world. Heart murmurs are the most common abnormalproblem whenapatients arevisitsthedoctorfor auscultation. These sounds of the heart are innocent, harmless or abnormal, which can be a symptom of serious heart disease. In this project, basic neural network tools are sing a neuron based network system. It used to differentiate people among healthy and disease susceptible patients. The heart sound recordings are collected and stored in the existing database. The different heart valve sounds are collected for the comparison and classification of Heart sound record from both healthy and pathological patients. It is having 300 heart sound recordings of length from 50 to 120 seconds. The first step of processing is to convert discrete values of audio file and then to divide the data samples using MATLAB tool. The multiple networks have been preparedwiththeheartmurmurinformationcontainedin heart beat recordings obtained from four different heart sound. These samples are segmented and preprocessed usingMATLAB.

I. INTRODUCTION

The Heartdisease is one of the major health issues which causes higher death rates in the world. Cardiovascular disease (CVD) is the major cause nearly half of the deaths in Europe (48%) and 34.3%inAmerica(1in2.9deathsintheUnitedStates). Detecting CVDs at an early stage is crucial for applying the corresponding treatment and reduce the potential risk factors. Auscultation is one of the most used techniques for this purpose, and can provide clues to the diagnosis of many cardiac abnormalities by listening and the heart sound components can be analyzed using echocardiogram. It is cost effective and requires minimal equipment. However, physicians requires more training and experienceforauscultating. Also the80% result can be achieved by expert cardiologists.The rate of auscultation process is about 20%-40% and the heart sounds are produced when blood flows through the valves of the heart which are audibleenough.Murmursmaybesilence,whichareprimarilyduet ophysiologicconditionsoutsidetheheart,orabnormal, which may be a sign of a more serious heart condition or a structuraldefectinthe heartitself.Themostcommonproblems thatcauseabnormalheartmurmursaremitraloraorticstenosis and mitral or aortic regurgitation. The sounds can be categorized based on timing as systolic and diastolic and based on the differ part of the hearton which they can be heard (between the S1 and S2 are systolic and S3 and S4, are diastolicrespectively).Heartmurmursarethemostcommonabno rmalitieswhen the patient visits the physician for auscultation. A heart murmur does not necessarily lead to having a CVD; it could be an innocent murmur instead of a pathological one, which does not represent current or future illness. The physician must decide if the patient is healthy or not, but, due to the fact that the accuracy is not great, the expert could be wrong, making category-I or -II errors. The category-I erroris analpha errorand rejecting the null hypothesis when it is true, and the category-II error is beta error it is failing to reject the null hypothesis. The pathological patientsaresenthomewithoutmedicationortreatment.It is clear that,inthiscase,type-IIerrors aremore important to avoid. However, the cost of echocardiograms ranges $750 to $1500 per patient, making category -I errors to avoid. There are already many systems proposed on this system based on the electro cardio signals produced by the electro cardio gram (ECG) machine. The signals are first sampled with the time period and voltage of the signal.

The sampled signals are compared and classified according to the values that are already stored in the existing database inside the system. The system compares the sampled signals with the pre-defined existing database values. While comparing, the system classifies the healthy and unhealthy signals by the MATLAB code which is mainly used to sample the given input signals. Then the sampled signals which are being converted into discrete values. Those sampled values are main part, which is mainly compared to the given input sampled input signals. Those signals when fed up in the MATLAB tool which is present in the system. There the tool which is mainly used for the regression of values inside the system.

II. NEURAL NETWORKS OVERVIEW

Neural networks is a biological nervous system which is trained to simple elements and it operate parallel. These elements are working on the principle of biological nervous systems. Naturally the contact between thecomponents largely controlto the function of networks by adjusting the values of the connections between components inside the function of network.Itcan also train a neural network to do particular function normally, neural networks are made, or trained, so that a particular input function that primes to a specific target value. The network is modified, on a association of the output and the target value, until the network output matches to the target data. Usually, many such input or target data are requiredto make a trained network.

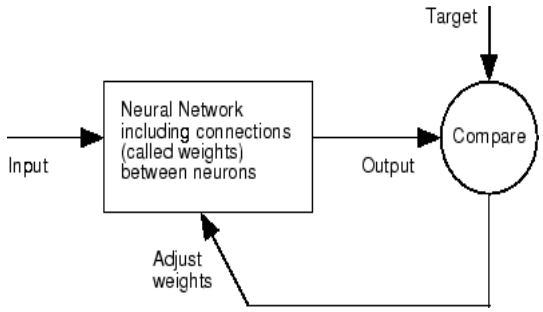

Fig 1.Functional diagram of neural network

Neural networks functions are used to train thecomplex functions in various area, likerecognition of patterns, speech, vision, control systems,AI, identification and classification inside the real world.TheNeural networks are also able to train to solve problems that are tough for conventional computers and human brain. The neural network toolhighlights the use of neural network examples that build up to many functions. They are also used in engineering, financial, AI andreal-world applications.

III. SOFTWARE COMPONENTS

A. Function Fitting And Approximation

Training the neural network is the main part present in the process for solving various identification and classification programs. There various input samples are trained according to scope of the field, the system is going to work. Those trained samples does a major role in setting up of target outputs from the trained inputs data.

B. Pattern Recognition And Classification

The process explains the setting up of input data from a set of input patterns with allocating the correct target data classes. After training the network, it can be able classify patterns even it was not trained on and also explains the process

of exercising a neural network function to allocate the correct target data classes to a set of input patterns. Once we trained the network, then it can be used to classify patterns even it was not trained on.

C. Clustering

To classify the resemblance of the patterns and other relative characteristics the training process based on the patterns is mainly done. It is mainly useful in gaining insight inside the functions and making it simply before further processing for the training of neural network.

D. Input-Output Time-Series Prediction

The Heart sounds are primarily collected stored in the existing database. This prediction find the future values of future values through the past values. There the inputs are fed up, processed, and then the recognition of outputs are made by the subject's classified input data.

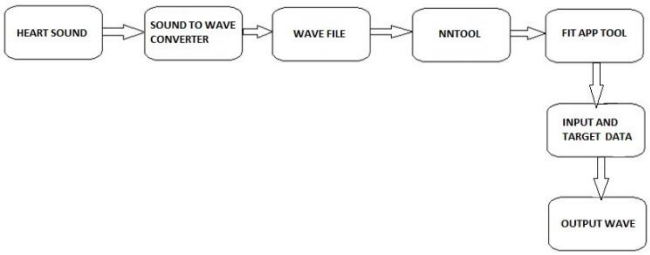

Fig 2.Block diagram showing the flow of working

E. Sampling Process

A Sampling process is a process of converting continuous time signal to a discrete time signal. Our project ismainly based on the sampling process is conversion of wav file to a sequence of sampling in each audio wave.

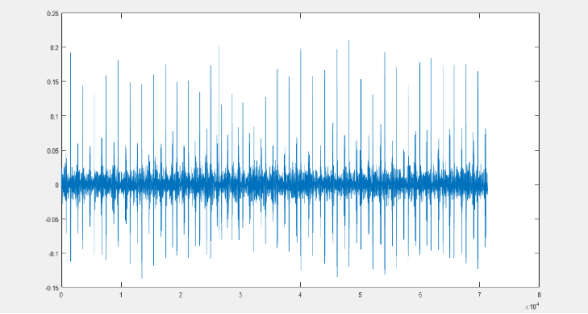

Fig 3. Sampled soundwave signal of a sound recording

The heart sound recordings are collected and stored in the existing database.The different heart valve sounds are collected for the comparison and classification of Heart sound record from both healthy and pathological patients. It is having 300 heart sound recordings of length from 50 to 120 seconds. The first step of processing is to convert discrete values of audio file and then to divide the data samples using MATLAB tool. After this process is finished (generating 6000 to 20000 Samples in one audio signal). Audio samples are send to the datasets in neural network.

F. Dataset Acquisition

The heart sound recordings are stored in theexisting database. Heart sound record from both hale and hearty also for pathological patients. Recording sounds are classified into two types. They are normal and abnormal heart sounds. The heart sound recording were collected from different areas of different heart valves namely aortic, pulmonic, tricuspid, Mitral areas inside the heart. TheResult will be showing as the normalrecordingswerefromhealthysubjectsand another category the abnormaloneswerefrompatientwas definite through the cardiacdiagnosis, which is not confirmed, but they made be indicating the coronary arterydiseasesandheartvalvedefectslikemitralvalveprolapse, aortic stenosis, valvularsurgery and mitral regurgitation. Audio recordings from the database were sampled and have been classified into three different sets 75%ofthemtoset the data intothenetwork,15%forvalidation and10%totestthenetwork

G. Multilayer Neural Network

The multilayer neural network isto solve the classification problems of nonlinear function.The architecture is shown in fig .4.All the input elements have individual weights neurons. Then the total number ofbiased inputs and preference forms an input data to the transfer function *f*. Neurons can use any different transfer function *f* to generate the output.

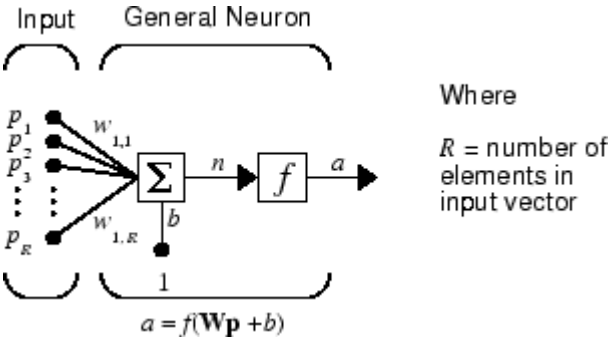

Fig 4. Architecture of Multilayer Neural Network

Multilayer networks often use the log-sigmoid transfer function logsig.

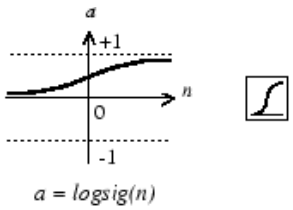

Fig 5. log-sigmoid transfer function

The logsig function is generate the outputs of the function commonlybetween 0 and 1, as the neuron's net input data ranges between negative to positive infinite function .The multiple layers networks can be used to the tan-sigmoid transfer function is known as 'tansig'.

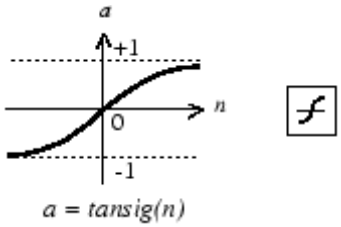

Fig 6. Tan-sigmoid transfer function

The Sigmoid function mainly basedon output of the neurons. They are used for pattern recognition and identification problems, while linear output neurons are used for this function fitting and classification problems. The linear transfer function (purelin) is shown in the fig 7.

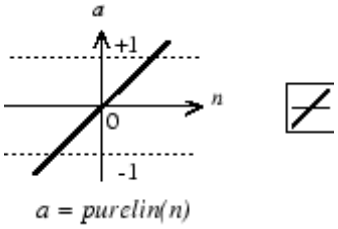

Fig 7. Linear function

Since all the three transfer functions are explainedthere are the most commonly used for transfer functions in multilayer networks, but other differentiable transfer functions can be created and used if desired.

H. Feedforward Neural Network

The feed forward network layer is a biological classification system it have n no of input layers. They are connecting to the hidden layer. The architecture is shown in fig8.

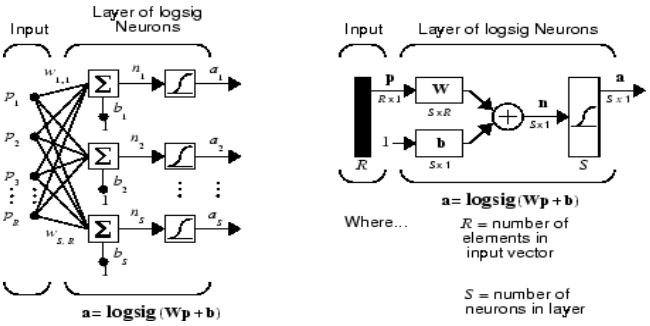

Fig 8. Architecture of feedforward Neural Network

Feedforward networks consists of one or more input layers which are connected to the hidden layer from other input layers of sigmoid neurons followed by an output layer from the input data functions of the linear neurons. The Multiple layers of neurons with nonlinear transfer functionsallows the network which arepast trained to studythe nonlinear relationships between input and output vectors from the basic set of elements present from the field of dataset.

The linear output layer is used for function fitting or nonlinear regression problems .On the other side, if you want to constrain the outputs of a network mainly as between 0 and 1, then the output layer should use a sigmoid transfer function such as logsig.This is the case when the network is used for pattern recognition problems in which a Decision is being made by the network.The multiple-layer networks is the number of determines the superscript on the weighted matrix. The appropriate notation is used in the two-layer tansig /purelin network shown next.

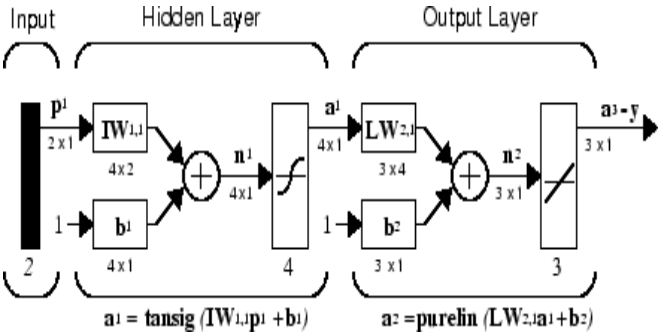

Fig 9. Architecture of Neural Network

This Network can be used as a general functionapproximately. It can approximately any function with a finite number of discontinuities randomly well, given appropriate neurons in the hidden layer.

IV. RESULT

Normal waveform of a healthy subject without any murmurs. The waveform is mainly converted into frequency domain function and divided into samples as shown in the figure.10.

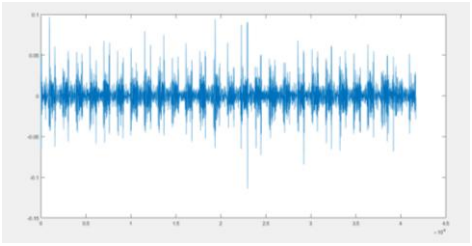

Fig 10. Waveform of normal subject

Pathological waveform of an unhealthy subject with murmurs. The waveform is mainly converted into frequency domain function and divided into samples in the figure.11

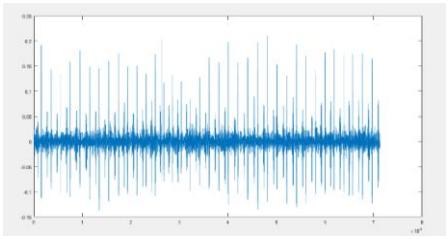

Fig 11. Waveform of pathological subject

Regression plot of Normal subject compared with two subjects, there the plot showing the perfect condition of a healthy subject matches with fit-line,found when comparing with the database. So the function is linear.

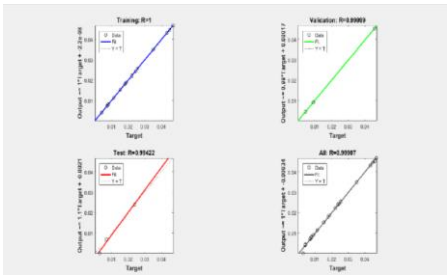

Fig 12. Regression plot of Normal subject

Regression plot of Pathological subject, when comparing with the database records the waveform showing the abnormal condition. The fit-line doesn't match with the regression line, so the function is non-linear.

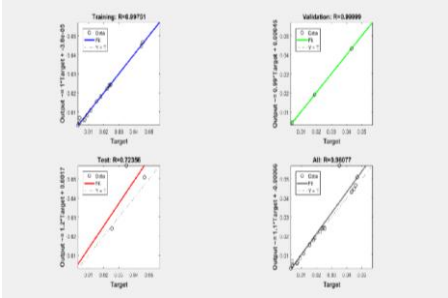

Fig 13. Regression plot of pathological subject

Regression plot of classification showing the identification of murmurs in pathological subject compared to the database values and to classify the type of problems.

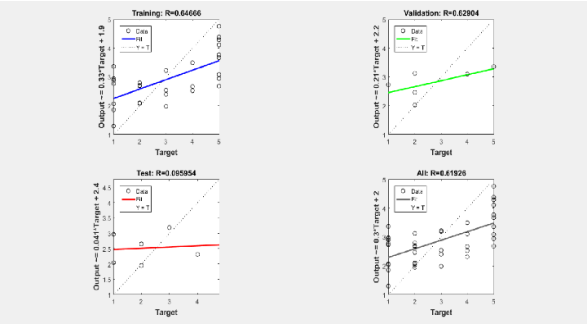

Fig 14. Regression plot of classification

V. CONCLUSION

In this project we have presented a useful of detection and classification of heart murmurs, using neural network which is mainly based on the comparison between the normal and pathological subjects. The heart sound recording from the physionet database. The different heart sounds collect form database. Heart sound record from both healthy and pathological patients. Inorder to produce an associated set of target outputs thereis a training process on the neural network on a set of input called as Function Fitting. It consists of 300 heart sound recordings duration from 50 to 120 seconds. The recording sounds are divide into two types normal and abnormal heart sounds. The heart sound recording were collect from different area of the heart valve: aortic, pulmonic, tricuspid, Mitral areas. The normal responses were observed from the healthy person and the abnormal responses were observed from the patients who are suffering from coronary artery. Once the neural network is trained to handle the data simplifies the relationship between input and output data so that it can be used to generate outputs.

VI. REFERENCES

A.M.Nichols, N.Townsend, P. Scarborough,R.Luengo-Fernandez,J. Leal, A.Gray, and M.Rayner, “European cardiovascular disease statistics 2012: European heartnetwork.
brussels,”*Eur.Soci.Cardiology*,SophiaAntipo- lis,2012.

[2] D. Lloyd-Jones *et al.*, “Heart disease and stroke statistics-2010 update a report from the American heart association, ”*Circulation*, vol.121,no.7, pp. e46–e215,2010.

[3] D.Roy,J.Sargeant,J.Gray,B.Hoyt,M.Allen,andM.Fleming, “Helping family physicians improve their cardiac auscultation skills with an inter- active CD-ROM,” *J. Continuing Edu. Health Professions*, vol. 22, no. 3, pp. 152–159,2012.

[4] E. Etchells, C. Bell, and K. Robb, “Does this patient have an abnormal systolic murmur?” *Jama*, vol. 277, no. 7, pp. 564–571,2014.

[5] S. Mangione and L. Z. Nieman, “Cardiac auscultatory skills of internal medicine and family practice trainees: a comparison of diagnostic profi- ciency,” *Jama*, vol. 278, no. 9, pp. 717–722,2016.

[6] M. Lam *et al.*, “Factors influencing cardiac auscultation proficiency in physician trainees,”*SingaporeMed.J.*,vol.46,no.1,pp.11–14,2015.

[7] S.L.Strunic, F.Rios-Gutiérrez, R.Alba-lores, G.Nordehn, andS.Bums, “Detection and classification of cardiacmurmursusing segmentation techniques and artificial neuralnetworks, ”in*Proc. IEEE Symp.Comput. Intell. Data Mining*, 2015, pp.397–404

[8] K.Ejaz,G.Nordehn,R.Alba-Flores,F.Rios-Gutierrez, S.Burns, and N. Andrisevic, “A heart murmur detection system using spectrograms andartificialneuralnetworks.”in*Proc.Int.Conf.Circuits,Signals,Syst.*, 2014, pp.374–379.

[9] F.Rios-Gutierrez,R.Alba-Flores, and S.Strunic, “Recognition and classification of cardiacmu rmursusingANN and segmentation,”in*Proc.22nd Int. Conf. Electr. Commun. Comput.*, 2012, pp.219–223.

[10] H. M. Hadi, M. Y. Mashor, M. Z. Suboh, and M. S. Mohamed, “Classification of heart sound based on S-transform and neural net- work,” in *Proc. 10th Int. Conf. Inf. Sci. Signal Process. Appl.*, 2010, pp.189–192.

[11] H. Hadi, M. Mashor, M. Mohamed, and K. Tat, “Classification of heart soundsusingwaveletsandneuralnetworks,”in*Proc.5thInt. Conf.Electr. Eng. Comput. Sci. Autom. Control*, 2008, pp.177–180.

[12] L. Jia, D. Song, L. Tao, and Y. Lu, “Heart sounds classification with a fuzzyneuralnetworkmethodwithstructurelearning,”in*Proc.Int.Symp. Neural Netw.*, 2012, pp.130–140.

[13] M. Singh and A. Cheema, “Heart sounds classification using feature extraction of phono cardiography signal,”*Int.J.Comput.Appl.*,vol.77,no.4, pp. 13–17,2013.

[14] T. Leung, P. White, W. Collis, E. Brown, and A. Salmon, “Classification of heart sounds using time-frequency method and artificial neural net-works,”in*Proc.22ndAnnul.Int.Conf.Eng.Med.Biol.Soc.*, 2010,vol.2, pp.988–991.