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Design of Mathematical Model for Selecting Appropriate Therapy & for Prediction of its Result

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Abstract:

This research work presents an effective application of artificial neural network for cardiac arrhythmia classification. Design of a mathematical model and unique cardiac chamber which help the clinician for the selection of appropriate therapy and prediction of heart rate variability after its successful implementation. Depending upon the heart rate variation after effective therapy implementation it also helps to predicts the deficiency of nitric oxide in blood vessel which is indirect method.The diseases that affect the cardiovascular system are the main cause of deaths in developed countries. Most of these deaths are due to sudden cardiac arrest and severe cardiac arrhythmia. Therefore, the automatic detection of cardiac arrhythmias from the bedside or ambulatories ECG becomes an important tool for risk assessment. Automatic real time analysis is performed by using artificial neural network. Following three consecutive steps are required for automatic detection: 1) R-R interval detection 2) Heart Rate Calculation and 3) Classification. After heart rate classification by neural network, mathematical model will suggest appropriate therapy for the patient depends on its heart rate and blood pressure. Suggested therapy is first line emergency treatment for the patient suffering from high heart rate, low heart rate, low diastolic blood pressure and high systolic blood pressure.

Keywords: *Neural Network, ECG, Arrhythmia, Color Therapy, Oxygen Therapy*

I. INTRODUCTION

Clinical practice involves diagnosis of the patient condition from the information collected during the query session, physical examination and laboratory test data, and then suggesting the most appropriate therapy based on the collected data. Correctness of such practice mainly depends on the knowledge and the skill acquired by the clinician through many years of practice. Many times, the procedure is observed to be cumbersome and time consuming. Also the complication involved in taking the decision with more number of variables may lead to an incorrect and less

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effective diagnosis that further increases the severity of the disease. allows the clinician to act as an expert while dealing with such complicated problem [1].

Mathematical modeling can be used for a number of different reasons. How well any particular objective is achieved depends on both the state of knowledge about a system and how well the modeling is done. Developing scientific understanding through quantitative expression of current knowledge of a system; to test the effect of changes in a system; aid decision making, including tactical decisions by managers,strategic decisions by planners.

II. MATERIALS ANDMETHODOLOGY

The classifier is developed using artificial neural network for analysis of cardiac arrhythmia.Real time ECG signal is imported in MATLAB its RR intervals are extracted and convert into correct heart rate. Extracted heart rate is given as input to the neural network for further analysis.

Neural network performs the classification of patient data either as normal heart rate when heart rate is in between 60 to 100 BPM or high heart rate if heart rate is more than 100BPM (Tachycardia), slow heart rate if heart rate less than 60 BPM (Bradycardia).

Closed air tidies chamber is design with oxygen supply and high intensity red light and blue light. Red light 150 Watt with high intensity is shine on the person which penetrates extremely in body. Person setting in front of this red colored light is continuously monitored by measuring its blood pressure and heart rate with the help of automatic BP apparatus and ECG machine. Time of red light that shines directly on the person may depend on its capacity and its physical body parameters.

Percentage of oxygen in air is measured with the help of oxygen sensor, normal percentage of oxygen in air is around 20 to 21%. Percentage of oxygen in chamber is increase using oxygen cylinder and its percentage is measured, simultaneously heart rate and blood pressure of the person inside the chamber is monitored. Aim is to develop mathematical model using MATLAB as shown in fig. (1) and design of unique cardiac chamber.

Neural network performs analysis of heart rate in three categories normal, low and high heart rate these heart rate along with blood pressure of patient is given as input to the mathematical model. The role of mathematical model is to suggest most appropriate therapy to the clinician depends on the heart rate and blood pressure of patient. The mathematical model will suggest Red light color therapy, Oxygen therapy and Blue light therapy depend upon patient data. It also predicts the variation in heart rate after successful implementation of appropriate therapy and help to predict the deficiency of Nitric oxide in blood vessel.

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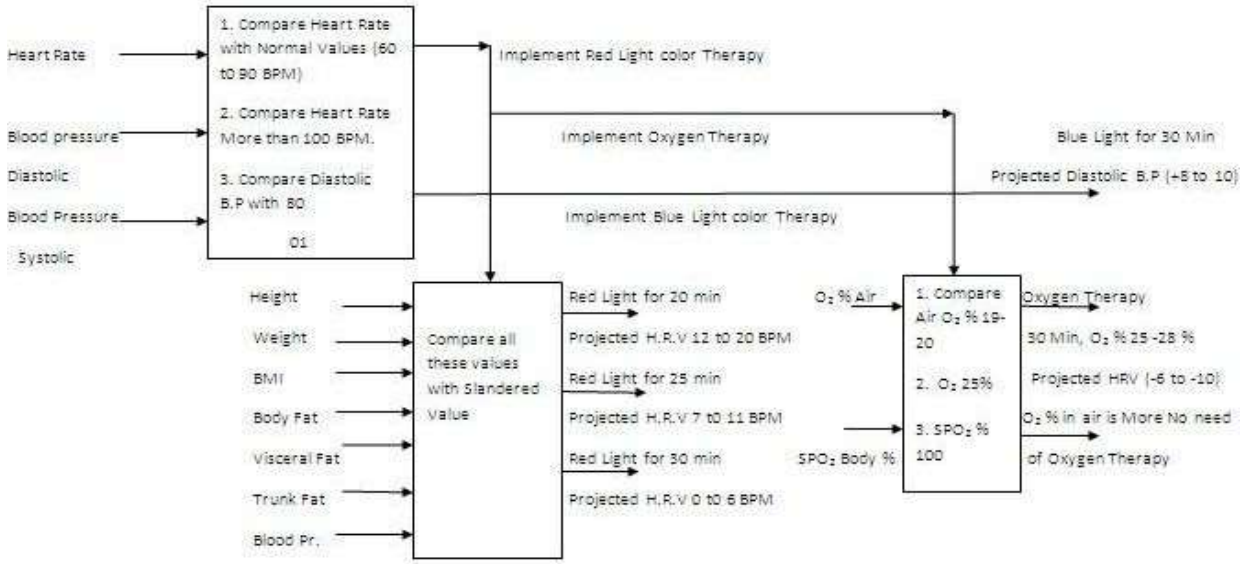

Figure (1) Design of Mathematical Model

III. RESULT AND DISCUSSION

Feed forward neural network which is train using Conjugate Gradient Algorithm with three layers, Input layer and two hidden layers,Neurons in Input layer are 100 and neurons in hidden layer are 80, 60 respectively is design for the analysis of cardiac arrhythmia. Trasfer function used in hidden layer are tansig and ouput layer is linear trasfer function purelin.

ECG wave form as shown in figure (2) its features are extracted in MATLAB ,its R-R intervals are converted into heart rate.Most of the heart rate is in range of 66, 66, 65, 65, 65, 65, 65BPM.

Figure (2) ECG wave form

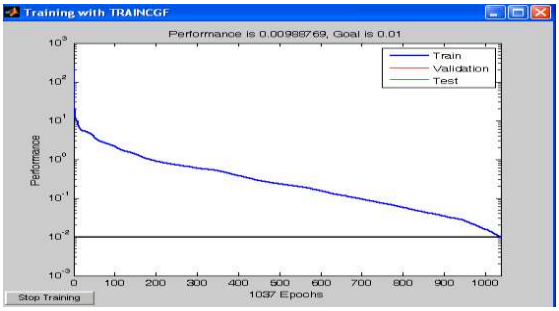

Figure (3) Error Graph for Testing of Neural NetworkTRAINCGF, Performance goal met.

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Neural network perform analysis of above patient wave form and observe the symptoms of bradycardia as shown in error graph figure (3). This output of neural network is applied to mathematical model to suggest appropriate therapy and its time. Bradycardia means low heart rate mathematical model suggest the Red light therapy for the patient. To decide time of therapy, patient various body parameters like visceral fat, body mass index, trunk fat, body fat % and muscle mass are applied as input to mathematical model. To project the heart rate variation after red light therapy patient blood pressure, hemoglobin %, age is applied as input. For this patient various body parameters are given in table (1).

VARIOUS BODY PARAMETERS

TABLE I

BMI 20.1-23	Trunk Fat <15	Body Fat 10-20	Muscle mass 33-36%	Visceral Fat 2-8
19.8	15.2	18	35.8	4

Blood pressure 87:122 Systolic and diastolic respectively, hemoglobin 13.5 % and age is 25years. Mathematical model performs analysis of all body parameter and suggest red light therapy for 15 min and projected heart rate increased by 10 to15 bit per minute after successful implementation of red-light therapy for 15 min. now this person is subjected to red light therapy and its body parameters like blood pressure and heart rate are continuously monitored by automatic B.P. apparatus and ECG machine.

Figure (4) ECG wave form after Red Light Therapy

From the above ECG wave form heart rate of the patient after red light therapy is 77, 77,77,78,78, and 78 BPM. After red light therapy increase in heart rate is 13 BPM which is in the range of projected heart rate of mathematical model.

IV CONCLUSION

Detection of disorder using artificial neural network system gives promising result. It can be help clinical diagnosis system. It required minimum time i.e 30 sec to 90sec to perform the analysis of ECG data with more than 2000 samples of RR intervals. It can be a good to improve the speed of diagnosis to the conventional clinical diagnosis system.

The results of the present study demonstrate that breathing concentrations of oxygen above 21 per cent produces a dependent decrease in heart rate in the most of the cases.

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We are proposing red light-colored therapy for the person with low heart rate and oxygen therapy for the person with high heart rate. At the same time, we are proposing unique cardiac chamber and mathematical model which help the clinician for selecting most appropriate therapy depend upon patient body parameter and expected result from the therapy for cardiac disorder which may be helpful for settling heart rate and blood pressure.

It can be said that this research work is a small step in the direction of developing an extremely useful technology.

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