Original Article

Diagnosis of Diabetes Based on Nadi Pariksha Using Tridosha Analysis and ANN

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ABSTRACT

In this work, a non invasive technique is proposed to detect diabetes from *tridosha* analysis. This system uses ayurveda knowledge for diagnosis of diabetes based on human constitution (*prakriti*). This system uses three piezoelectric pressure sensors mounted on human wrist for capturing *Vaat*, *Pitta* and *Kapha* signals respectively. These three signals are then amplified and filtered using signal condition unit. By analyzing the variations in these signals, respective *dosha* is identified and *prakriti* of a person is determined. Along with *tridosha* analysis, artificial neural network (ANN) is used for pattern classification purpose. For training of ANN different features extracted from signals are applied as input. ANN is trained using back propagation algorithm to minimize the error and differentiate normal and diabetic person.

Keywords: Artificial neural network, diabetes, piezoelectric pressure sensor, tridosha analysis, Nadi Pariksha.

INTRODUCTION

The present methods that are adopted for diabetes detection are invasive. These methods involve collecting blood sample from patient followed by some chemical analysis. For pulse acquisition, *ayurvedic* doctor uses three fingers starting from index finger, middle finger and ring finger as shown in Fig.1. These three fingers represent three doshas i.e. Vaat, Pitta & Kapha respectively. Since these three pulses have different pulse rate it is difficult to hear or feel three distinct pulses simultaneously.

In ancient literatures, be it Ayurveda, Chinese, Unani, or Greek, pulse based diagnosis has its own unparalleled importance. The organ under distress is zeroed down by feeling the palpation from the three fingers placed on the radial artery. These pulsations dictate the Physiological status of the entire human body. This is a tedious and inconvenient process and hence it takes years of practice to master this art. As a result this approach is subjective in nature.

AYURVEDA THEORY

Each person is born with one of the seven prakritis, Vaat, Pitta, kapha, Vaat-Pitta, Vaat-Kapha, Pitta-Kapha or Sama prakriti. Ayurveda does not comply with the 'general line of treatment approach' of modern medicine. As it is a complete health treatise which restores the balance of doshas in the body thereby ridding the body of the disease. According to ayurveda, an individual suffering from Diabetes Mellitus Type-II shows aggravated kapha dosha and vaat dosha. Diabetes Mellitus is known to Indians from Vedic period onwards by the name Asrava (Prameha).They were treating this problem very effectively at that also. Diabetes is also known as Madhumeha in Ayurveda. In Ayurveda there are six stages of the disease process and western medicine doesn't acknowledge a disease until the fifth stage of this process. If we can mitigate a provoked dosha before it gets to that stage, we have a much better chance at maintaining health and preventing disease.

SYSTEM ARCHITECTURE

In this work, human wrist pulses are captured using three pressure sensors which works on the piezoelectric principle. The proposed block diagram of the system is as shown in Fig.2

1. Data acquisition and pre-processing.

The Nadi pulses are sensed by the fingertip, which actually measure the pressure exerted by the artery. These pulsations are very minute in pressure units and therefore their acquisition is very challenging. Human pulse is detected on the radial artery at a position shown in Fig.1. Piezoelectric pressure transducer is used for detecting the human pulse. This sensor has the advantage that it detects the dynamic pulse pressure and rejects the static pulse pressure operating on it, when it is pressed against the wrist. The electrical signal proportional to the pressure obtained from sensing element is then amplified and filtered using series of amplifiers. After amplification, data is acquired using NI USB-6210 multifunction data acquisition card having an interface with the personal computer. The data is captured at a sampling rate of 500 Hz (which is sufficiently higher than the Nyquist criteria) for a predetermined length of time. The minimum change in the signal, which can be measured, depends solely on the resolution of the digitizer.

2. Feature extraction

The pulse is acquired in MATLAB and the features are determined. The parameters of the pulse like shape, rhythm, amplitude, frequency and the pulse rate are focused for extraction of Nadi features. Pulse rate is calculated by detecting the peaks in each pulse signal. From various literature, the pulse rate of the normal person is given as, for vaat 80-95, pitta 70-80 and kapha=50-60. The variations in these extracted features are observed and prakriti of subject is determined. For more precise prakriti determination, questionnaire is given to the subject

3. Design of Artificial Neural Network

The features extracted from the signals are used to train the neural network. Back propagation algorithm is used for training to get minimum error (MSE) in classification.

Neural Network Toolbox available in MATLAB is used for pattern classification purpose. The neural network is trained as per algorithm shown in Fig.4 The training data set which includes time domain features extracted from waveforms is created. This data set is used to train the network. While training the network, the number of hidden layer neurons is adjusted by trial and error way so as to get minimum error. The data samples are randomly divided into three kinds training, validation and testing. Training multiple times generated different results due to different initial conditions and sampling.

RESULTS AND DISCUSSIONS

First signals are acquired using data acquisition card and MATLAB itself as measurement software. For that purpose, Data acquisition toolbox available in the MATLAB is used. Raw signal acquired is as shown in Fig.5. Such three signals are acquired and plotted. The patient suffering from diabetes shows excess pulse rate of kapha signal and also peak amplitude value is found to be lowered. Neural network is trained using Back propagation algorithm to minimize the error. The sample database for the training purpose is given in Table 1. The performance of trained neural network is shown in Fig.6. For the demonstration of the results, a Graphical User Interface (GUI) is created in MATLAB as shown in Fig.7.

CONCLUSIONS

A non invasive diagnosis technique is implemented for diabetes detection. This system will be used to detect diabetes using two methods, tridosha analysis (ayurvedic diagnosis) and ANN as soft computing tool. Also a real time PC based system is developed which allow user to check his/her prakriti at any time based on heart rate variability. Furthermore, a back propagation algorithm based ANN is designed to classify the signals for further diagnosis. Further study can be done for diseases such as cancer or cardiovascular diseases.

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Table No.1 Sample Data for Training

Features	Subject 1			Subject 2			Subject 3		
	Vaat	Pitta	Kapha	Vaat	Pitta	Kapha	Vaat	Pitta	Kapha
Pulse rate	95	65	60	80	95	60	75	75	90
R level	0.963	0.963	0.963	0.85	0.550	0.550	0.90	1.05	0.650
Mean	0.287	0.287	0.223	0.345	0.359	0.354	0.394	0.452	0.169
Power in Frequency	0.166	0.166	0.166	0.19	0.192	0.192	0.157	0.157	0.157

Fig. 1 Standard positions to obtain pulse

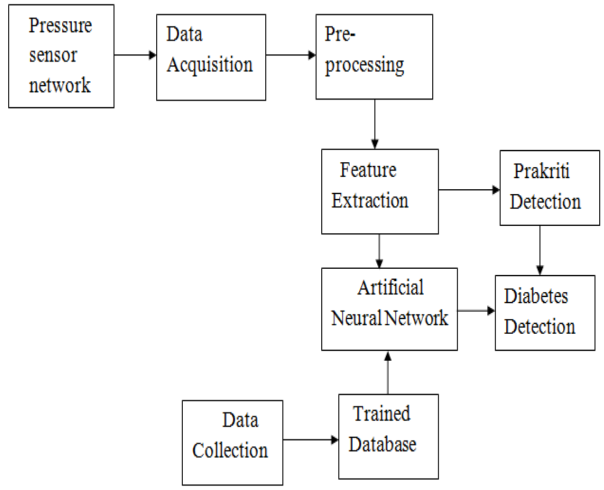

Fig 2. Block Diagram of System

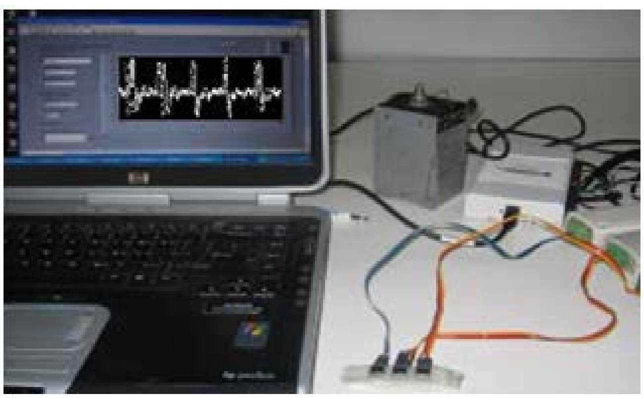

Fig.3 Complete Setup

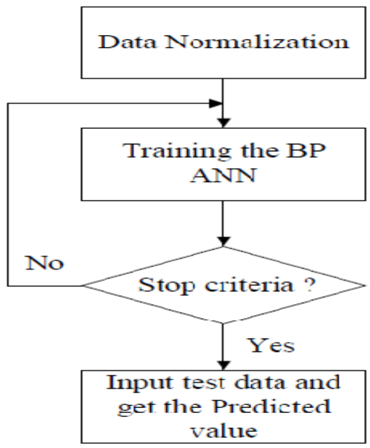

Fig.4 Training of ANN

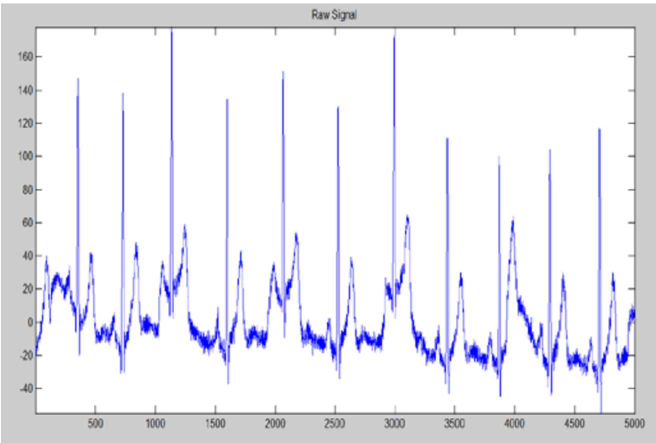

Fig.5 Raw signal acquired

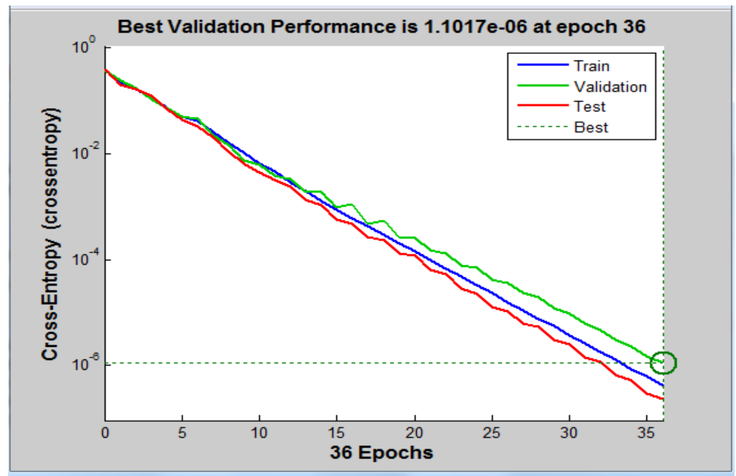

Fig.6 Neural Network Performance

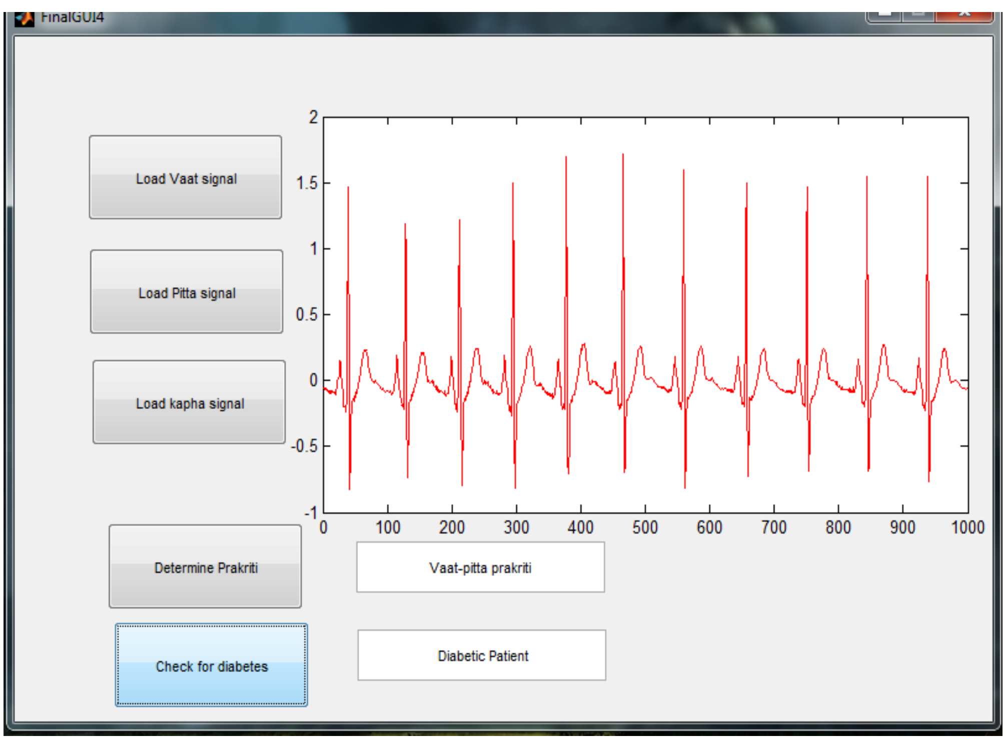

Fig.7 Final Result