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Ayurveda based Disease Diagnosis using Machine Learning

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Abstract - *Diagnosing diseases on time is the most crucial factor in reducing the mortality rates due to late disease detection. Ayurveda makes use of Nadi Pariksha i.e. pulse examination in order to achieve the same. The main aim of this project is to design a non-invasive system of Nadi Pariksha to assist medical practitioners in the diagnosis of various ailments. The affected organ is found out by the pulse palpation from the three fingers, namely, index, middle, and ring, placed on the radial artery at the wrist. The number of patients dying because of late diagnosis is increasing day by day. Under such circumstances being able to monitor the health of the patient through time to time observation of their pulses and thereby identifying any abnormal situation as soon as possible could be beneficial in saving lives. Integrating this process of pulse examination with modern technology would provide a tool for early disease recognition and diagnosis thereby decreasing the mortality rate. To implement to Sparshana phase of Ayurvedic Disease Diagnosis, we will be acquiring the patient's pulse using optical sensors and then be applying Artificial Neural Network algorithm on the obtained waveform in order to identify the patient's Prakriti, i.e. Vata, Pitta or Kapha. Further, Decision Tree algorithm will be applied to a questionnaire that resembles the Darshana and Prashna phases.*

Key Words: **Artificial Neural Networks, Decision Trees, Ayurveda, Pulse diagnosis, Machine Learning**

1.INTRODUCTION

Nadi Pariksha/Pulse Diagnosis is a non- invasive ancient technique of ayurvedic disease diagnosis through pulse. It accurately diagnoses physical, mental and emotional imbalances as well. It is also the scientific tool that enables a person to secure their personalized wellness regimes such as therapeutic massages, personalized diet, and detoxification. The time tested and age-old natural way of healing, Ayurveda, has taught that any presence of disease in our system will be indicated as an imbalance in our 'Doshas' - Vata, Pitta and Kapha. The principles of Ayurveda follow the natural way to diagnose diseases and bring back balance to the body, and one such mode of diagnosis is 'Nadi Pariksha'.

The proposed model uses Artificial Neural Networks and Decision Trees to create a tool that can take the VPK pulse readings using optical sensors so as to detect the Prakriti(VPK) of the patient. This covers the Sparshana phase of the three-fold Ayurvedic Diagnosis. Questionnaires have been formulated for the two diseases considered, Anemia and Hyperacidity, respectively. These questionnaires are used as substitutes to the Darshana and Prashna phases.

1.1 Ayurvedic Pulse Detection

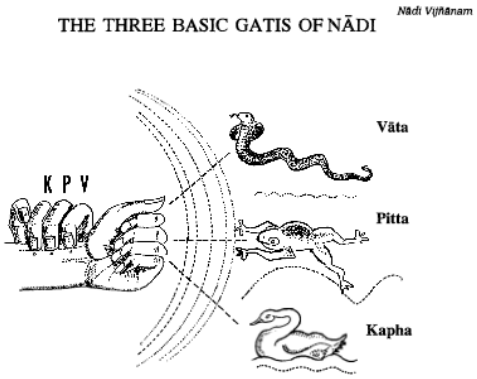

Fig -1: The VPK Pulses

1.2 Vata Pitta Kapha Characteristics

Table -1: VPK Characteristics

Dosha	Primary Functions
Vata	Movement and Communication
Pitta	Digestion and Transformation
Kapha	Cohesiveness, Structure, and Lubrication

1.3 The three-fold Ayurvedic Diagnosis

A. Sparshana

Sparshana, touching or palpation method of diagnosis is the first in trividh pariksha (three-fold diagnosis), in which the practitioner examines the person by touching. The Prakriti (Vata, Pitta, Kapha) of the person is determined. This phase is implemented in our project using optical pulse sensors and Artificial Neural Networks.

B. Darshana

This is the direct observation diagnosis. The general physique type, movements, etc are observed. This phase has been implemented in our project using Decision Trees.

C. Prashna

The physician asks in detail about the background of the disease, his/her lifestyle, eating habits, change in any activities lately, etc. This is implemented in our project using Decision Trees.

2. RELATED WORK

The paper by Begum and Divaakar proposes the use of pressure sensors to detect pulse. As the pressure of the sensor over the pulse increases, the amplitude of the pulse signal first increases, reaching a maximum, and then decreases. After a particular threshold value, the pulse dies. [3]. A comparative study of implementation of various techniques for pulse sensing are discussed such Microphone as a sensor, Pressure as a sensor, Bi-Sensing Pulse Diagnosis Instrument in the paper by Chauhan[1]. Roopini et al proposed a device for Nadi Pariksha. It uses eighth order Butterworth filter for preprocessing of the three signals using optical pulse sensors so that the noise is eliminated. Three pulse sensors are used for the three signals to be visualized. The pulse data is then further classified into vata, pitta,and kapha using artificial neural networks [9]. Khair and Joshi proposed a method for detecting the pre-meal and post-meal difference in a person using pulse. Results to their experiment showed that pulse signal carries useful information for classification of pre-meal and post-meal signal. Pre-meal classification had an accuracy of 88.88%, while post-meal showed an 81.48% accuracy [2]. Kulkarni and Kumbhar developed a non invasive diagnosis tool for detection of diabetes using two techniques, i.e. tridosha analysis and application of artificial neural networks[5].

3. PROPOSED METHODOLOGY

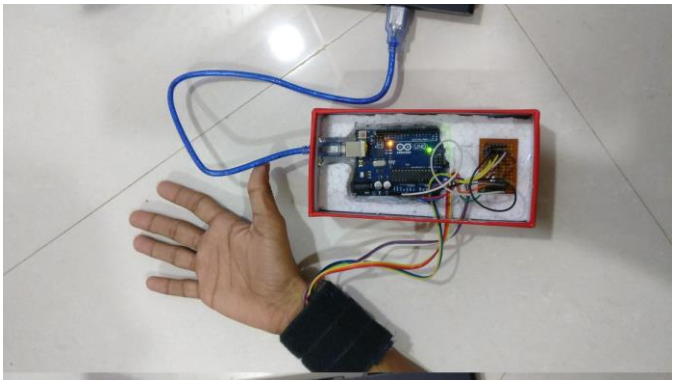

Fig -2: Hardware Setup

We propose a system which encorporates the three phases of Ayurvedic disease diagnosis. The first phase of Sparshana is implemented using three optical pulse sensors that are placed at the three locations on the human wrist as shown in Fig. 1. These pulse sensors are interfaced to our system using the Arduino Uno microcontroller via USB connection. The Arduino board requires a 5V power supply to operate. It has 14 digital input/output pins out of which 6 can be used as PWM outputs, 6 analog inputs, a 16MHz crystal oscillator, a USB connection, and a power jack.

The sensor captures the pulse readings in analog form which are converted to digital values via Arduino's ADC. These sensors basically put together a simple optical heart rate sensor with amplification and noise cancellation circuitry making it quicker and easy to get reliable pulse readings with higher accuracy. The three pulse sensors are attached to a Velcro strap to minimize external light interference. This Velcro strap is then wrapped around the patient's wrist to obtain their pulse readings.

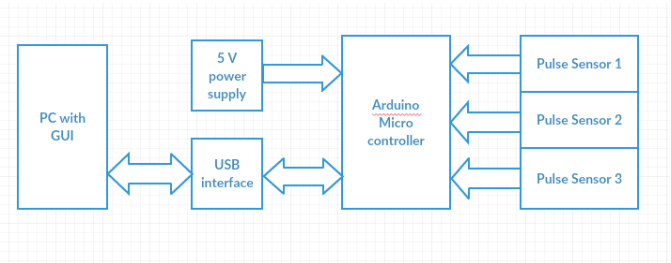

Fig -3: Block Diagram

Table -2: Disease Symptoms

Disease	Symptoms
Anaemia	• Breathlessness • Fatigue • Lack of Concentration • Pale Skin • Tingling Sensation • Edema • History of bleeding • Anorexia • Palpitations • Low Haemoglobin Count
Hyperacidity	• Heartburn • Bloating Sensation • Indigestion • Episodes of Reflux • Nausea • Burping • Vomitting blood • Flatulence • Headache • Abdominal Pain • Vertigo

The next two phases, namely, Darshana and Prashana are implemented in our system using a questionnaire. We've chosen two diseases, namely, Anemia and Hyperacidity based on which questionnaires are formed depending upon their most common symptoms(Fig -2). Patient response is captured and stored in MySQL database along with patient details for future access.

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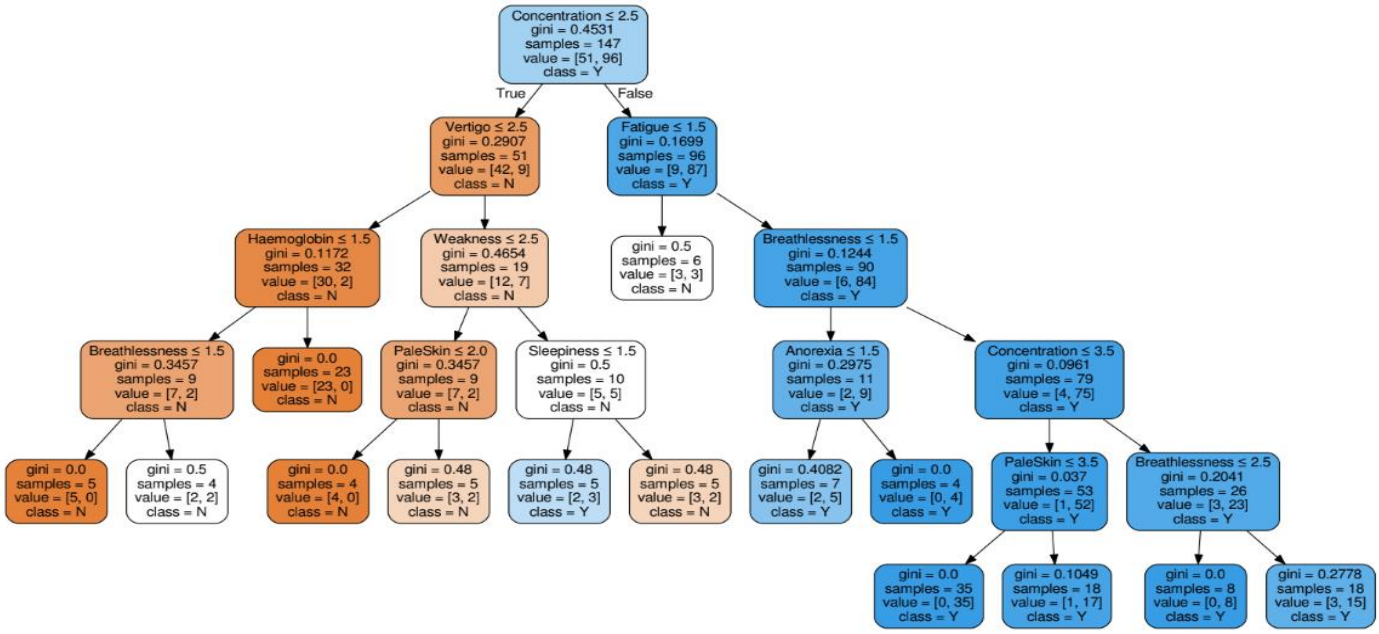

Fig -4: Decision Tree – Anemia

Artificial Neural Networks are used to predict the Prakriti of the patient i.e. vata, pitta or kapha. ANN uses a single hidden layer of 4 units. Two separate Decision Trees are implemented each for Anemia and Hyperacidity to predict the outcome of the questionnaire i.e. if the patient has Anemia or not and if or not the patient is suffering from Hyperacidity.

The pulse readings are pictorially represented using graphs for introspection by doctors.

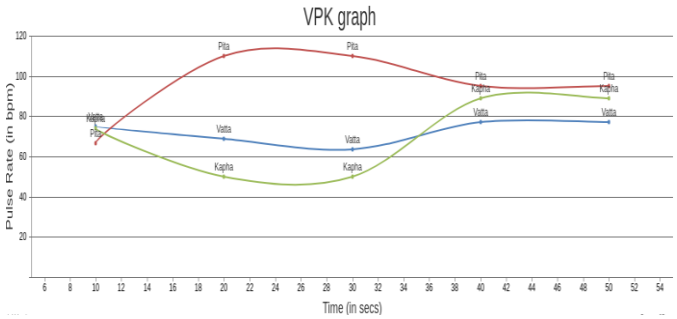

Fig -5: VPK graph

Data was collected using the optical pulse sensors setup and fed as training dataset to artificial neural networks algorithm. This training data set was labeled with the help of an Ayurvedic doctor.

The decision tree implemented was pruned at 5 levels to avoid overfitting of data and also minimum samples per leaf node was set to 3. The report generated contains pulse data along with the filled questionnaire which can be used to assist Ayurvedic doctors in making accurate diagnosis.

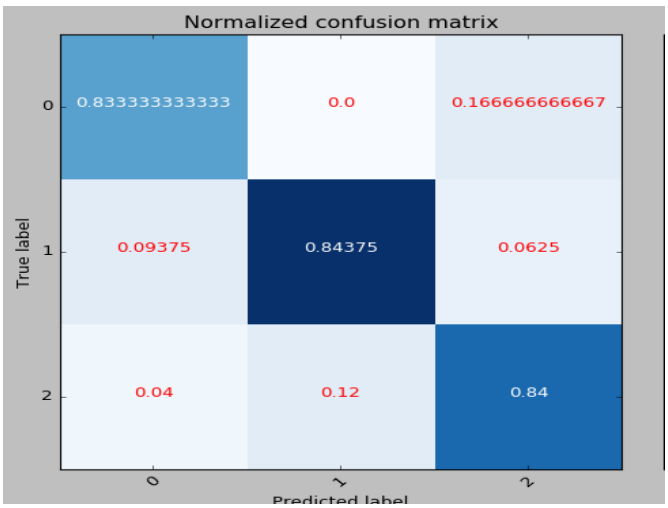

Fig -6: Confusion Matrix

The confusion matrix is shown in Fig -6. The labels 0, 1 and 2 represents three prakrutis namely vata, pitta and kapha respectively. The figure shows that accuracy of 84% is obtained in prediction of patient's prakruti using ANN.

4. CONCLUSIONS

The proposed methodology brings together the idea of Ayurvedic Pulse diagnosis and use of modern technology. Human error in Ayurvedic pulse diagnosis can be minimized with the help of standardized hardware. The doctor can access all their patients current and previous records. The patient data can be sent remotely to the doctor and processed results can be made available. System can be improved to train new and inexperienced Ayurvedic doctors in the art of pulse diagnosis.

The number of diseases diagnosed by our system can be increased and more training data can be collected to further enhance the systems accuracy. This system can be deployed in rural areas where availability of doctors is low. Any person with non medical background can be trained to use this system in such areas thereby helping in early diagnosis of diseases.

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