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Pulse Sensor Design for Disease Diagnosis

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Abstract:

The fundamental base of all traditional medical practices lies on the concept of three radial pulses. Three pulses are given the names vata, pitta and kapha by the traditional practices. Here these pulses are acquired using simple piezo electric sensor and heart beat continuously recorded using a pulse oximeter setup, an LCD display for heartbeat display. Mean factor of the three pulses are calculated with respect to the heartbeat and age of the respective subject and displayed using MATLAB. Thus the equipment is tested for 5 subjects of different ages and tested whether they are prolonged to any diseases.

Key words: Radial pulses, Traditional medicine, MATLAB

1. Introduction

Traditional medicine and natural healing system in India and many other countries are mainly based on palpation techniques. Pulse diagnosis system aims mainly on finding any disease using nadi pulses which shows related information of the human body. In ancient literatures like Ayurveda, Chinese, Unani, or Greek, pulse diagnosis has its own importance. The organ under distress is detected and cured by feeling the palpation from the three fingers (index, middle and ring) placed on the radial artery. These pulsations indicate the Physiological status of the entire human body. This is an inconvenient process and hence it takes years of practice to expertise this art. As a result this approach is subjective in nature.

The system is being evaluated by Ayurveda practitioners as an automated probable disease output watcher. Pulse has been accepted by modern clinicians as well. They examine the pulses using the trisection method i.e. apply pressure until the pulse is maximal, and then vary pressure while concentrating on the phase of the pulses. The arterial pulse variants (for example pulses alternans, bisferiens pulse, bigeminal pulse) are basically used in cardiac disorder detection. Alternative medical practitioners carefully examine pulses at different depths, each connected with specific parts of the body and each believed to register even the slightest physiological based changes. The main Objectives for this, are by providing a convenient and non-invasive computer aided device which eliminates all the human errors performed manually by Indian medicine practitioners in the disease diagnosis. To provide a device which is easy to use, uniform in diagnosis and quick in response, which the performance will be based on accurate with quantitative information. Ayurveda means the 'science of life' this system believes that cosmos composed of five basic elements - air, water, earth, fire and space. Human life is considered as a configuration of three humors (Vata, Pitta and Kapha), seven tissues and three mains (waste products). According to ancient literature, any element in the body brings about a change in the constitution of these humors.

2. Materials and Method

2.1. Hardware Part

The pulses from the radial artery are mainly related to the blood flow and heart rate of a human body. If there is a malfunction of heart or any of the body parts related to the heart flow cause changes in the heart rate and thereby the pulse appearance. This change in the pulse, even minute changes show the change in your normal balancing of body function. Thus, using a piezoelectric sensor the three pulses are cached, IC with PIC16F877A chip level programming and MPLAB IDE software is used in pulse acquisition. LCD for heart rate display. The signals acquired are processed in MATLAB and SNR signals are displayed with the mean factor for three pulses.

The mean factor shows which pulse is increased and which pulse is normal for each subject. Through which the health condition of the subject can be explained.



Figure 1: Traditional system of pulse diagnosis

Figure 2: Three radial pulses

	1 st Pulse	2 nd Pulse	3 rd pulse
Location	Index	Middle	Ring
Frequency	80-95	70-80	50-60
Regularity	Irregularity	Regular	Regular
Amplitude	Low +	High+++	Moderate++
Tension and Volume	Low	High	Moderate
Temperature	Cold	Hot	Warm to cool
Vessel wall	Rough hard	Elastic Flexible	Soft thickening

Table 1: Characteristic properties of three pulses

3. Acquiring the Radial Pulses

3.1. Hardware Part

The piezoelectric sensor placed at the radial and palmary arteries, senses the three radial pulses. These pulses are processed using embedded system. MPLAB software for acquiring the proper signal. IC chip with pic16F877A chip level programming. Here complex instruction set is used.

The pulse oximeter setup is designed for acquiring the blood flow display and real-time heart rate monitoring is done using an LCD display. Thus heart rate can be displayed which plays an important role in the pulse diagnosis.

16 pin LCD displays is used, two pins for anode and cathode. This LCD display is connected to the IC chip. Thus the acquired pulse rate can be displayed in the LCD for present reading. 5v current is used here. The least significant bit and the most significant bit are taken. The LCD works with the resistance applied. It first removes earlier data and start displaying the new data.

UART used here, universal asynchronous receiver and transmitter includes a DC baud rate of 9600 and a crystal oscillator with a frequency $F = 1/T$. Analogue to digital conversion occurs here, the analogue signal is then converted into digital values. These values are then sending to the software part.

3.2. Software Part

The signals collected are passed over to the software section. The three acquired pulses are together called as tridosha. The mean factor of tridosha is calculated with respect to the age and Heart rate of the subject. The SNR of the signal is taken for noise removal. Here vata will be of lower value, pitta medium and kapha will be the higher one. The properties and the mean factor value shows whether the person got vata, pitta or kapha higher and thereby comes to a conclusion that whether the person is prolonged to any kind of disease or health problems. According to traditional ayurvedic studies the mental condition of the subject can be defined by the values obtained.

4. Results

The mean factor measured for different subjects are shown below in the table.

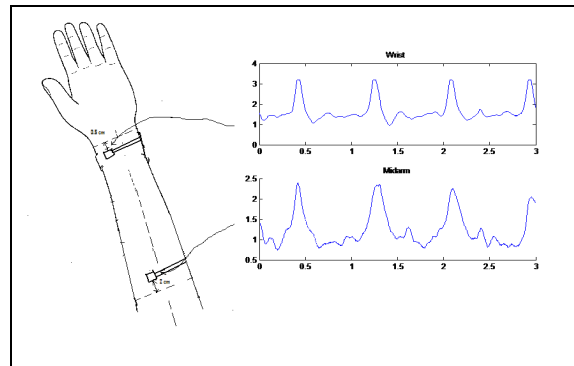


Figure 3: The mean factor calculated

The resulting graph obtained is shown below. The ranges of each value will be different compared to the other subject as well as each pulses. The mean factor for subject of

Age group like from 0 to 10 will be approximately same mean factor and for subjects with age around 20 to 30 will be approximately same. The values of man are taken from the left hand and for women are from right wrist. Thus comparing the mean factor, the olden medical system like ayurveda, siddha, traditional Chinese practitioners can easily predict the disease habit of the respective subject.

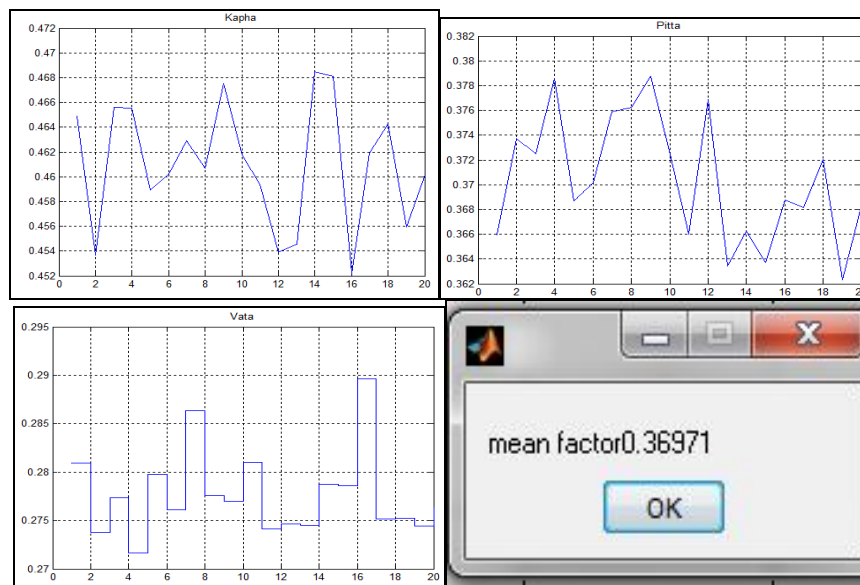


Figure 4: Three radial pulse wave forms with mean factor

5. Discussion and Conclusion

This system will be very useful to the Indian Medicine Practitioners as an automated computer-aided diagnostic tool. This tool helps in diagnoses of chronic diseases in the human body and reveals detailed and related information of the human body. Medical practitioners will also give a clear idea about which part of the body is affected by the disease, so that the accurate medicine can be provided. The change in the pressure on the vein, changes the meaning of the pulse.

For a person with higher vata pulse may be prolonged to diseases such as Prana Mental, Respiratory, Neurological, Ears, Nose, Throat, Neck, and Speech, Circulatory, Systemic disease, Excretion, Constipation, Menstrual, Sexual

When the pitta pulse is increased, it may leads to diseases like Digestion, jaundice, acid stomach, jaundice, Blood disorders, liver, Decisiveness, Memory, Intelligence, Spiritual inclination, Emotions, Vision, Eyes and skin diseases.

Increased kapha pulse get increased from the normal rage may leads to Digestion, mucous, the root of all other Kapha's, Back, Heart, Lungs, Taste, Smell, Senses, Cough, Nasal Congestion, Cerebral spinal fluid, headache, Joint pain, congestion.

RIGHT SIDE

Dosha	Vata	Pitta	Kapha
Finger	Index	Middle	Ring
Superficial	Colon	Gallbladder	Pericardium
Deep	Lung	Liver	Circulation

LEFT SIDE

Dosha	Vata	Pitta	Kapha
Finger	Index	Middle	Ring
Superficial	Small Intestine	Stomach	Bladder
Deep	Heart	Spleen	Kidney

This paper can be modified for more accurate values by improving the hardware efficiency. Using three sensors instead of one gives better performance. Implementation of Lab VIEW software for faster and simple processing. A cuff could be used to fix all the three sensors on the wrist and can be used for getting the pulses simultaneously which can give reliable results. With the help of medical practitioner more fine values can be obtained. Future research will be concentrated on the diagnosis of diseases like (Cancer types and Sugar level) using our improved version of an instrument. These three pulses can be referred for specific diseases give more detailed information about diseases such as diabetes, heart disease, respiratory problem and others. Thus the present idea can be developed for more accurate and innovative ideas. Since this three pulse concept is not scientifically proved, more studies related to this must be done.

Subjects	Age Group	Mean Factor
Subject 1	5	0.36971
Subject 2	11	0.46987
Subject 3	18	0.49381
Subject 4	25	0.56887
Subject 5	32	0.66971
Subject 6	36	0.59871
Subject 7	42	0.77094
Subject 8	53	0.86987
Subject 9	66	0.96887
Subject 10	70	0.95412

Table.2: Mean Factor of Subjects with Different Age Group

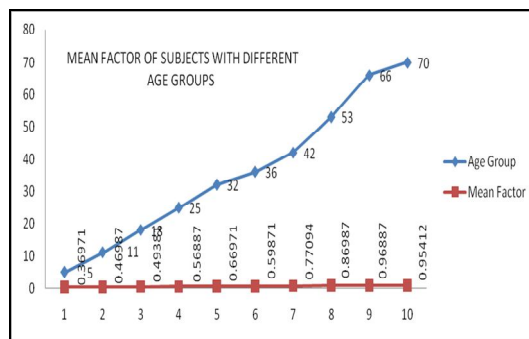


Figure 5: Chart for mean factor calculated

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